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ABSTRACT

This document presents the case study of a training program for elementary science teachers to determine if certain teacher training techniques would influence the onset and the quality of the implementation, and ensure the survival over time of an elementary science curriculum innovation. Teachers instructed in the curriculum innovation were divided into four skills groups: (1) group support and collaboration; (2) group support and no collaboration; (3) isolate with collaboration; and (4) isolate with no collaboration. The major hypothesis predicted that the amount of innovation implementation would vary from a high degree of accomplishment by those teachers in the first group to a low degree of implementation by teachers in the fourth group. Study results revealed significant differences among the groups but not in the direction predicted. Several suggestions for redesigning the study to provide a clearer test of the hypothesis conclude the document. Appendixes present materials related to both the curriculum innovation and teacher training techniques. (RA)

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Analysis of the Introduction and Implementation of Curriculum Innovations

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TABLE OF CONTENTS

CHAPTER I. CONCEPTUAL BASIS OF THE STUDY 9

- Introduction 9
- Review of the Literature 13
    - Groups 14
- Implication of the Study 21
    - Implementation 21

CHAPTER II. PROCEDURES OF THE STUDY 26

- Selection of a Participant 30
- Description of the Project Schools 30
- Description of the Teacher Population 31
- Training Program 35
- Observer Training 36
- Implementation 39
- Instruments 40
    - Observation Form 41
        - For Dyads: 42
        - For Isolates: 42
    - Semantic Differential 42
    - Personal Information Sheet 43
    - Dyad Growth Instrument 44
    - Follow-Up Sheet 45

CHAPTER III. TRAINING PROGRAM 47

- Tuesday Sessions: Including Philosophy and Content of the New Science Unit 48
    - First Session 48

Second Session 49

Third Session 50

Wednesday Sessions: Including Philosophy and Content of the New Science Unit, and Procedures Designated by the Investigator as Collaboration Skill Practice 54

First Session 54

Second Session 55

Third Session 59

CHAPTER IV. FINDINGS OF THE STUDY 66

Introduction 66

Theory-Based Data 67

Sums of Minutes Observed Taught Over Four Observations 67

Criterion Level for Implementation 70

Minutes Reported Taught 70

Average Minutes Taught Per Time Taught 72

Attitude Change 75

Treatment Condition 1: Dyads, Content and Collaboration Skills 76

Treatment Condition 2: Dyads, Content Only 83

Treatment Condition 3: Isolates, Content and Collaboration Skills 83

Treatment Condition 4: Isolates, Content Only 84

Observer Commentary -- A Taxonomy 84

Pupil Actions, Verbal, Positive -- 85

Pupil Actions, Manipulative -- 87

Observer Evaluates Teacher, Positive and Negative -- 87

Further Judgmental Data 89

Preparation Time 89

Preparation Time Per Time Taught 90

Average Preparation Time Per Week -- Comparison Between Weekly Reports and Follow-Up Report 93

Collaboration Skill Training 95

Preliminary Follow-Up Data 97

Lessons Completed 97

What Has Been the Response of Other Teachers in Your School? 99

What Changes Would You Suggest in the Lessons? 99

My Willingness to Use the Unit Again Next Year 101

Responses of My Class to the Unit 101

How Comfortable Do You Feel with the Content? 103

Final Follow-Up 103

CHAPTER V. DISCUSSION 107

The Study 107

Limitations of the Study 110

Observer Training 110

Training Program 111

Experimental Schools 113

Some Major Outcomes 116

Suggestions for Further Study 120

Summary 121

REFERENCES 123

APPENDICES

Appendix A. Implementation Observation Form 125

Appendix B. Semantic Differential 127

Appendix C. Personal Information Sheet 131

Appendix D. Yardstick for Measuring the Growth of a Pair 132

Appendix E. Follow-Up Sheet 134

Appendix F. Teacher's Guide 137

Appendix G. Tuesday Sessions, Transcripts 166

(1) Second Session 166

(2) Third Session 184

Appendix H. Wednesday Sessions, Transcripts 205

(1) Second Session 205

(2) Third Session 228

Appendix I. Observer Commentary -- A Taxonomy: Classification of Observer Comments 247

LIST OF TABLES

TABLE 1. DESCRIPTION OF THE TEACHER POPULATION 33

TABLE 2. SUMS OF MINUTES TAUGHT OVER FOUR OBSERVATIONS, INCLUDING PROJECT OBSERVATIONS AND REPORTS BY TEACHERS OF UNOBSERVED TEACHING 68

TABLE 3. TWO-WAY ANALYSIS OF VARIANCE FOR MINUTES OBSERVED TAUGHT 69

TABLE 4. CRITERION LEVELS FOR TIME TAUGHT, INCLUDING VARIATIONS OF INDIVIDUAL TEACHERS FROM IMPLEMENTATION CRITERION (30 MINUTES/LESSON FOR 4 LESSONS OBSERVED) AND EXPECTATION CRITERION (60 MINUTES/WEEK FOR 4 WEEKS, OBSERVED AND NOT OBSERVED) 71

TABLE 5. AVERAGE MINUTES TAUGHT PER TIME TAUGHT 73

TABLE 6. TWO-WAY ANALYSIS OF VARIANCE, AVERAGE MINUTES TAUGHT PER TIME TAUGHT (RATIO) 74

TABLE 7. t TEST DATA FOR THREE ADMINISTRATIONS OF SEMANTIC DIFFERENTIAL INSTRUMENT TO TEACHERS IN TREATMENT CONDITION 1 -- ISOLATES: CONTENT AND COLLABORATION SKILLS 77

TABLE 8. t TEST DATA FOR THREE ADMINISTRATIONS OF SEMANTIC DIFFERENTIAL INSTRUMENT TO TEACHERS IN TREATMENT CONDITION 2 -- DYADS: CONTENT ONLY 78

TABLE 9. t TEST DATA FOR THREE ADMINISTRATIONS OF SEMANTIC DIFFERENTIAL INSTRUMENT TO TEACHERS IN TREATMENT CONDITION 3 -- ISOLATES: CONTENT AND COLLABORATION SKILLS 79

TABLE 10. t TEST DATA FOR THREE ADMINISTRATIONS OF SEMANTIC DIFFERENTIAL INSTRUMENT TO TEACHERS IN TREATMENT CONDITION 4 -- ISOLATES: CONTENT ONLY 80

TABLE 11. COMPARISON OF FIRST AND LAST MEAN SCORES ON SEMANTIC DIFFERENTIAL INSTRUMENT 82

TABLE 12. CLASSIFICATION OF OBSERVER COMMENTARY FOR THE FOUR TREATMENT CONDITIONS, CUMULATED OVER FOUR OBSERVATIONS 86

TABLE 13. TOTAL PREPARATION TIME REPORTED (MINUTES) FOR FOUR WEEKS 91

TABLE 14. PREPARATION TIME/TIME TAUGHT (RATIO) 92

TABLE 15. AVERAGE PREPARATION TIME PER WEEK -- COMPARISON BETWEEN WEEKLY REPORTS AND FOLLOW-UP REPORT 94

TABLE 16. COMPARISONS OF SCORES ON THE "GROWTH OF A PAIR" INSTRUMENT 96

TABLE 17. LESSONS COMPLETED 98

TABLE 18. WHAT HAS BEEN THE RESPONSE OF OTHER TEACHERS IN YOUR SCHOOL? 100

TABLE 19. MY WILLINGNESS TO TEACH THE UNIT AGAIN NEXT YEAR 102

TABLE 20. HOW COMFORTABLE DO YOU FEEL WITH THE CONTENT OF THE UNIT? 104

TABLE 21. STATUS OF INNOVATION AT FINAL FOLLOW-UP 105

LIST OF FIGURES

FIGURE 1. MAJOR FACTORS AND RELATIONSHIPS IN THE PRESENT STUDY 15

FIGURE 2. TEACHING EXPERIENCE (YEARS) 34

FIGURE 3. TEACHER AGES 34

FIGURE 4. OUTLINE AGENDA FOR THE TWO PARALLEL TRAINING PROGRAMS 37

FIGURE 5. PHASES OF THE STUDY, SHOWING ADMINISTRATION OF ALL MEASURES 44

FIGURE 6. CHANGES IN MEAN SCORES ON THREE CONCEPTS OVER THREE ADMINISTRATIONS OF THE SEMANTIC DIFFERENTIAL 81

CHAPTER I

CONCEPTUAL BASIS OF THE STUDY

Introduction

This study will determine whether the presence or absence of a group-variable during training influences the onset of implementation, quality of implementation, and survival over time of a curriculum innovation specified as a first-grade science unit together with the materials to back it up. Implementation is operationally defined as the teaching of lessons from this unit and use of the materials provided, when observed by project staff during four visits to a teacher's classroom.

The study seeks to clarify the usefulness of the application of small group theory to the design of in-service programs and the prediction of behavior of teachers who are implementing a new science unit at the first-grade level. All physical apparatus, materials, and directions necessary to carry out the innovation were provided.

Basic to the design of the experiment is the hypothesis that when a curriculum innovation is presented to a number of teachers, assigned either to groups (in this study dyads, i.e., two-person groups) or to individuals working alone on implementing the innovation, those teachers who work in groups will spend more time in teaching learning behavior related to the innovation per unit time than will those teachers who work alone, and the quality of teaching in groups will be higher than that done by isolates. This hypothesized effect should be further enhanced by training in collaboration skills, since collaboration skill training may be necessary to the successful functioning of teams. One criterion for implementation is the amount of time spent in teaching the innovation while a project observer is present. A second criterion has to do with how teachers feel about the innovation. This indication of implementation will be provided by scores made by participants on a semantic differential instrument. This instrument, designed by the investigator, attempts to measure the meaning of the innovation to the participant. It was administered before and after training, and at the conclusion of the implementation period. A third criterion is based on observations of teachers in the classroom.

Innovation in science education is a complex operation which probably requires a less naive orientation to what is involved than has been the practice so far. This study applies some small group theory, borrowed from social psychology, to conceptualize the problem.

Dyad is the technical term used for two persons interacting. The term applies to any two persons interacting, regardless of age, sex, occupation, or type of interaction.[1]

A dyad may also be a group, under certain specified conditions. The definition of a group employed in this study is "two or more individuals who, through social interaction, depend on one another to play distinctive roles in the pursuit of common interests or goals,"[2] in this case, the implementation of a new science unit.

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[1] Goodwin Watson, Social Psychology: Issues and Insights (Philadelphia: Lippincott, 1966), p. 14.

[2] William W. Lambert and Wallace E. Lambert, Social Psychology (Englewood Cliffs, New Jersey: Prentice-Hall, 1964), p. 87.

The focus of this study is on predicted differences in implementation behavior between teachers, half of whom come from schools in which they will be the only person teaching the innovation, and half of whom come from schools in which two people are to try out the innovation. The former are designated "isolates" and the latter are "dyads."

We may consider the teacher an isolate in relation to her status as sole implementer of an innovation, i.e., the only person from her school trained in the use of the innovation.[1] But in reality other factors are likely to have at least as much impact on her teaching behavior relative to the innovation. Some of those factors might be the attitude of the administration toward the innovation, the amount of pressure applied on the teacher to implement, the extent to which other teachers in her school reject or accept the innovation, support which the innovator receives from such diverse sources as friends, colleagues, administrators, spouse, or project staff; the degree to which the innovating teacher views her training group as a reference group. However, it is assumed that the same forces would be operating on the dyads.

When individuals trained in an innovation go back to a school in which they have no similarly trained cohorts they often find little support from fellow faculty and they have hardly any opportunity to discuss problems. In this study, groups are established to act as buffers against the pressures to maintain the status quo. Groups may help their members to accommodate to variables which do not foster implementation of the innovation.[1] Group members may be less likely to give in to such variables.

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[1] Matthew B. Miles (ed.), Innovation in Education (New York: Bureau of Publications, Teachers College, Columbia University, 1964), pp. 454-455.

In the group there are also possibilities, however, for the operation of factors which may negate the buffer and nurturance functions of the group. They may derive from properties of the interaction within the group itself. For instance, there may be a conflict within the group which in effect causes members to function, in terms of their implementation behavior, more like a person in the isolate condition. Such conflict might be picked up during the training sessions by observation of the groups, and would likely be picked up through interviewing teachers during the implementation period.

All of those influences suggested as potentially operating on isolates could also operate on individuals in the group when they are in their schools. On the other hand, since in the group situation in this study there is another person who has been trained at the same time and in the same way the partners could serve to support each other in implementation. In the face of elements that might encourage a negative response in the back-home situation partners may find it helpful to share problems, to talk over responses of children, etc.

The study of groups is well established and a considerable literature has accumulated.[2] The present study seeks to clarify the utility of the application of small group theory to the design of in-service programs and the consequent effect on the survival of the implementation.

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[1] Dorwin Cartwright, "Achieving Change in People: Some Applications of Group Dynamics Theory," Human Relations, 4:389, 1951.

[2] A. Paul Hare, Handbook of Small Group Research (New York: Free Press, 1962); Joseph E. McGrath and Irwin Altman, Small Group Research: A Synthesis and Critique of the Field (New York: Holt, 1966).

In this study a new science unit for the first grade serves as the implementation vehicle.

Review of the Literature

A study by Risk[1] has explored the relationship which may exist between an innovation introduced to a large group as a desirable methodology and the subsequent operation of members of this larger group as members of "clusters" or in "isolation." In this case the innovation was the Fernald kinesthetic approach to teaching a new word, and the large group in which a demonstration of the approach was given was composed of teacher trainees for elementary education. Total number of teachers was nineteen. Teachers in "clusters" evidenced individual average implementation of 33.2, whereas "isolated" teachers averaged 8.6 implementations. All "cluster" teachers at least attempted to implement the innovation. Fifty percent of isolates utilized the innovation.

Risk implies, without offering evidence, that the variance in implementation was largely due to the "cluster" and "isolate" conditions. Clinical findings reported by Risk, however, could easily lead the reader to consider other sources of variance as having a greater influence on implementation. She found that closely associated with high implementation were low economic level (school support) and a high estimated number of underachievers in reading. Associated with low implementation were a high economic level, remedial and diagnostic consultant services, prescribed curricula, and a high supply of basic reading materials. In short, it could be inferred that perceived relevance of the innovation to the particular population which is its eventual target may be at least as strong an explanatory factor as any group-variable.

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[1] Beverly Risk, "The Stress of Change," Michigan Educational Journal, 43:16-18, October 1966.

On the basis of the evidence reported, Risk has failed to indicate a relationship between group support and high implementation, though she has indicated that these two may occur together. The way in which the design of the study reported in this paper differs is shown in Figure 1. Figure 1 on page 15 illustrates relationships between the major factors which are examined in the present study. This Figure is a flow diagram which graphically relates each of the four experimental conditions to the two training conditions employed, to the intervening or mediating variables considered from the theoretical bases for the study, and to the relative amount of implementation predicted for each of the four experimental conditions.

Arrows in Figure 1 are intended here to indicate relatively accurate relationships between the four experimental groups and these mediating variables. For example, try-outs lead to some degree of implementation regardless of condition; rejection leads to non-implementation regardless of condition.

Groups

During recent years much emphasis has been placed on the group and grouping procedures and the effect these factors may have on classroom and other learning situations.[1] In this study, I was not concerned

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[1] Edgar H. Schein and Warren G. Bennis, Personal and Organizational Change Through Group Methods (New York: John (Continued on next page)

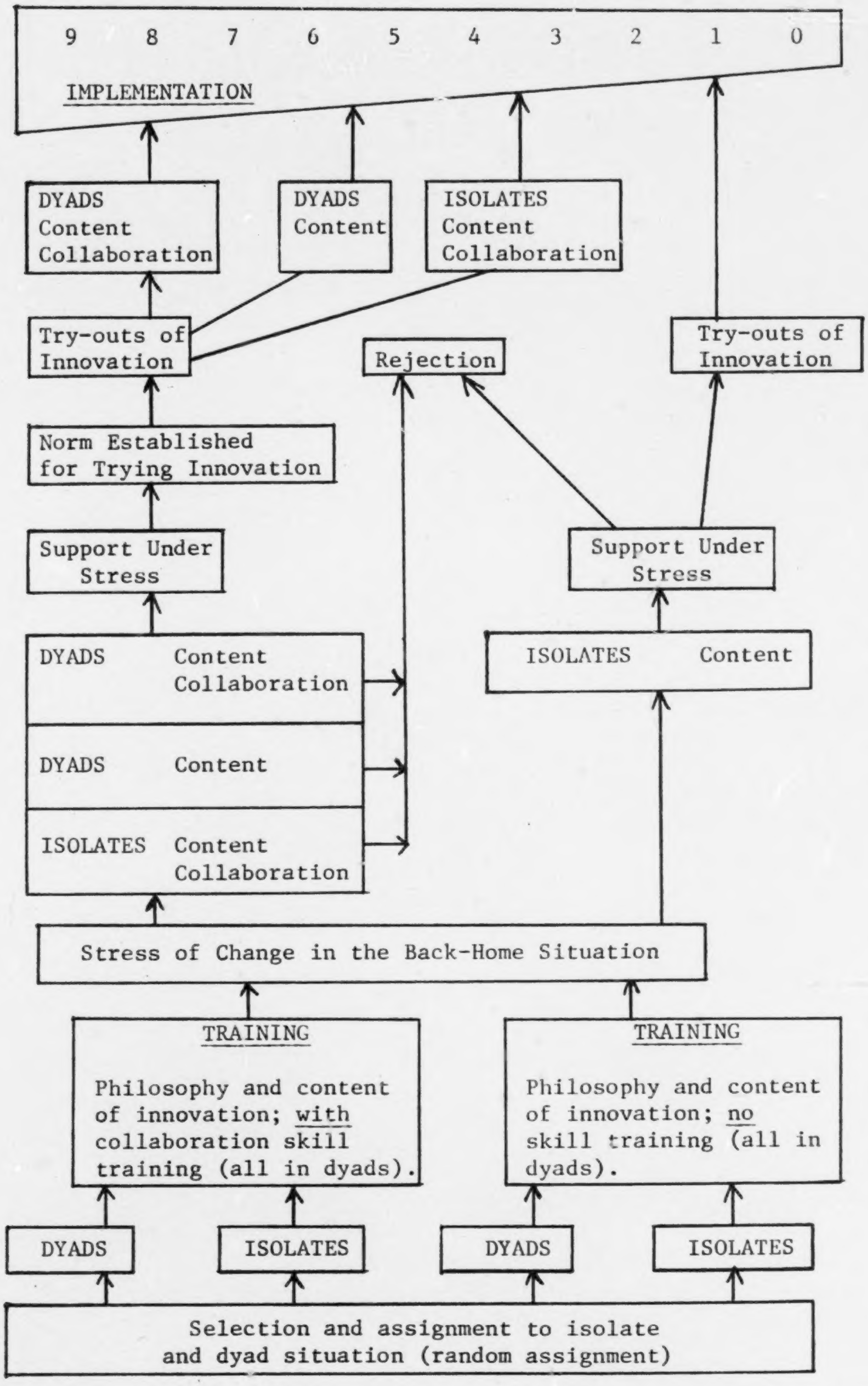
9 8 7 6 5 4 3 2 1 0
IMPLEMENTATION
DYADS Content Collaboration
DYADS Content
ISOLATES Content Collaboration
Try-outs of Innovation
Rejection
Try-outs of Innovation
Norm Established for Trying Innovation
Support Under Stress
Support Under Stress
DYADS Content Collaboration
DYADS Content
ISOLATES Content Collaboration
ISOLATES Content
Stress of Change in the Back-Home Situation
TRAINING
Philosophy and content of innovation; with collaboration skill training (all in dyads).
TRAINING
Philosophy and content of innovation; no skill training (all in dyads).
DYADS
ISOLATES
DYADS
ISOLATES
Selection and assignment to isolate and dyad situation (random assignment)

FIGURE I

MAJOR FACTORS AND RELATIONSHIPS IN THE PRESENT STUDY with grouping, per se, but rather with examining a hypothesis which proposed that certain characteristics of a group facilitate change and may lead to an output increment (in this study, number of implemented procedures) as well as increasing the chances for acceptance of the innovation.

While the study is basically guided by theory, it is definitely product-oriented, and as the investigator describes in Chapter II, follows an engineering design format rather than the more traditional hypothesis testing model. I have predicted that interaction with an implementation partner will produce an increment in time devoted to teaching-learning behaviors related to the new unit. The time-taught measure was taken by a trained observer in the classroom and in addition periodic self-reports of teachers were collected.

When an innovation is introduced in the elementary curriculum, the mere fact that it is a change may produce a certain amount of stress on the part of the teacher. She may be uncertain just how well she will be able to carry out the new task; this is especially the case with science. She may be anxious about the behavior of her children. What will her principal or subject supervisor think about how she is doing? If this teacher is the only person working with the innovation in her school, she may have virtually no one with whom to discuss problems which arise, with whom to share both perceived successes and perceived

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Wiley & Sons, Inc., 1965); K. M. Evans, "Group Methods," Educational Research, 9(1):44-50, November 1966; Kenneth H. Hoover, "The Effect of Structured Small Groups upon Attitude Change," Educational Research 9(3):233-236, June 1967; Hobart F. Thomas, "Sensitivity Training and the Educator," National Association of Secondary School Principals Bulletin, 51(322):76-78, November 1967; Mary Budd Rowe, "A Study of Small Group Dynamics and Productivity in the BSCS Laboratory Block Program," Journal of Research in Science Teaching, 4:67-73, 1966.

failures. The fact that the innovation is one in science has extra hazards in that, for example, "Science is culturally discrepant for females -- and there are a thousand subtle and not so subtle cultural cues that teach them their lesson. Yet at the primary level, it is women whom we are expecting to teach science."[1]

A study by Rowe[2] has emphasized differences between the perceptions of innovating teachers and their principals when the teacher has problems in implementing new science curriculum materials. By their nature many of the new science programs create an atmosphere of excitement, increase interaction between students, de-emphasize teacher domination of class time, make the teacher a sort of floating resource person, increase noise level in the classroom, and to the unprepared observer may give an impression of lack of order and loss of discipline. The teacher most often perceives the situation as one in which she is losing control, i.e., that the innovation creates disciplinary problems. Principals on the other hand tend to perceive the situation as resulting from the teacher's lack of competence in subject matter. So long as this difference in role perception and expectation exists the innovation is in danger of being rejected before adequate tryouts have been made.

Groups may be able to buffer a certain amount of stress inherent in this bind for the innovating teachers, at least for a long enough time to give the innovation a fair trial. Groups provide support for the unsure innovator. Each member of the group is capable of reinforcing his partner's behavior; by example, approval, empathy, and suggestion. Assuming that the dyad becomes a group according to the definition given above, the partners playing roles complementary to one another, then a norm relating to implementation of the innovation is likely to result. Collaboration is here conceived as a norm source, and the instructional job of training in collaboration skills is to convey a norm for implementation.

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[1] Mary Budd Rowe, "The Science Curriculum Improvement Study," (paper read at the American Chemical Society Symposium on Education, New York City, February 6, 1967), mimeo.

[2] Mary Budd Rowe and Paul DeHart Hurd, "The Use of Inservice Programs to Diagnose Sources of Resistance to Innovation," Journal of Research in Science Teaching, 4(1):8, March 1966.

The curriculum innovation itself involves some new teacher roles. Some teachers being trained already play these roles, but for others the changes required will be dramatic. The design of this study assumes some equitable distribution of teacher types across the four treatment conditions.

Dyadic groups have most of the characteristics of larger groups, and less of the negative features of larger groups. Consensus is more easily achieved. A greater intimacy of communication may be achieved, trust more easily built. Since this study was conducted in natural settings, the investigation of the group variable effect on implementation was restricted to dyads in order to minimize confounding of large group-small group variables.

The design of the training program provided for skill practice in the development of collaboration skills in the group for half of the participants in order to maximize the likelihood that a group situation will result for those so trained. This design option, as well as the decision to select teachers for this training program as isolates or or as dyads from their home schools, was long ago advocated by Cartwright.[1] Cartwright points out the influences which a strong, cohesive group can have in determining a member's behavior. Training in collaboration skills was introduced in this study to increase the chances for the formation of a cohesive group.

Selection of teacher dyads from schools, and their subsequent training in collaboration provides the basis for a two-pronged attack on one of the greatest weaknesses of workshops, aptly summed up by Cartwright:

> "A workshop not infrequently develops keen interest among the participants, high morale and enthusiasm and a firm resolve on the part of many to apply all the wonderful insights back home. But what happens back home? The trainee discovers that his colleagues don't share his enthusiasm. He learns that the task of changing others' expectations and ways of doing things is discouragingly difficult. He senses, perhaps not very clearly, that it would make all the difference in the world if only there were a few other people sharing his enthusiasm and insights with whom he could plan activities, evaluate consequences of efforts, and from whom he could gain emotional and motivational support. The approach to training which conceives of its task as being merely that of changing the individual probably produces frustration, demoralization, and disillusionment in as large a measure as it accomplishes more positive results."[2]

Since we do not know all of the factors that may operate on or in a group that is supposed to function in a natural setting, it is possible to imagine some undesirable outcomes. It is possible that a norm for rejection will develop. The group may develop a highly cooperative behavior pattern and uniformly refuse to teach the innovation. The group could break up, with either one or both of the partners refusing to interact with one another. Because of the great variety of responses possible on the part of participants, observers will collect information on the interaction of participants in both group and isolate conditions as the study progresses, including the time of training. This information may be useful in interpreting the results of the study since this is a clinical study that will seek to uncover some factors that produce an effective innovating group as well as to expose factors which result in dissolution of groups if that happens.

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[1] Cartwright, op. cit., pp. 381-392.

[2] Ibid., p. 386.

When the innovating teacher is considered in the context of her school, where the influences are not always optimal for the survival of innovations, the existence of another person working on the same innovation may have a strong influence on the survival of the innovation in practice. If the two work collaboratively the probability of successful innovation is even greater.

As mentioned earlier, the groups created in this study are not the only innovation reference groups possible for participants. Isolates may regard the original training program group as a reference group for their current behavior. But the likelihood of a reference group effect supportive of implementation is greater in the dyadic relation for several reasons. Dyad partners are in the same school and, at least in theory, have the opportunity to interact on a daily basis during the period of maximum stress, the observation period. The isolate has no comparable innovation-supportive relation provided for him, though of course he may establish one within his school or at home. The training of some isolates in collaboration skills with their partner during the initial training may lead to such a supportive relationship when the isolate returns to his school. This sort of interaction I would hope to pick up through carefully placed questions by the trained observers.

A related effect is possible in the situation where the teacher is a nun who lives in a convent. There is reason to expect that the living situation, especially communal meal times, may have a supportive effect reflected in implementation behavior.

In rare instances the isolate could use the original training group as a reference group. Circumstances work against this happening in one way because the training period is short and there is little time for the trainee to become acquainted with but one other person, and in another because there will be no follow-up meetings and there is little hope for the isolate that this group will meet again.

Implication of the Study

Isolates will serve as a control on groups in terms of implementation. The construct of positive interaction outcomes (i.e., collaboration skills, norm formation, support, and comparison) may have important implications for the design of training programs and implementation strategies. If it transpires that groups achieve higher mean scores on the criteria for amount and quality of implementation, then it would seem to follow that future programs for the introduction of elementary science innovations would do well to include strategies for the utilization of group effects in their design.

Implementation

Once the innovation is introduced, whether introduction is by individuals in isolation or in groups, to what extent does the teacher emit behaviors specifically related to the innovation? A related criterion is just how long the teacher continues to emit such behaviors (survival of the innovation in practice).

Most change studies are concerned only with the here-and-now, i.e., the period of the study is very short. Immediate changes in behavior which can be referred to a particular training strategy are certainly of value, at least as brief indicators of success. But unless criterion measures continue at the post-treatment level over a longer period of time than has been the custom, or level off (decrease somewhat) until they stabilize at a level that is still higher than their level prior to training, we may be measuring nothing more than a "Hawthorne Effect." The teachers may regress to pre-training behaviors. In this investigation observations were made throughout the time it took to teach the innovation. In addition the investigator looked into the status of the innovation with the teachers during the following school year (about six months later).

Adoption of an innovation is a complex phenomenon. In this study adoption is of importance since it expresses an acceptance of the innovation by the teacher; adoption is operationally defined by the teaching of the innovation beyond the trial period, when the teacher is under no pressure to continue use of the innovation. Adoption should not be confused with implementation, which in this study refers only to the teaching of the innovation during the period of observations by project staff.

Beal, Rogers, and Bohlen,[1] primarily concerned with agricultural innovations, have examined the concept of stages in the adoption process and generally found support for such a concept in the five innovation adoption processes which they examined. Their stages are (1) awareness, (2) information, (3) application, (4) trial, and (5) adoption.

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[1] George M. Beal, Everett M. Rogers, and Joe M. Bohlen, "Validity of the Concept of Stages in the Adoption Process," Rural Sociology, 22:166-168, March 1957.

Some innovations are material and others non-materials, i.e., they involve changes in patterns of functioning. Which category elementary science fits into cannot be so exclusively settled, however. The present science unit includes, as do most science teaching innovations, both material and non-material components. There is hardware, the physical equipment to be used, and software, the operational and conceptual skills taught as well as new knowledge of facts. Katz[1] has found that material items (e.g., the physical materials used with the unit, or in the case of Katz's study, the biological Streptomycin) are more readily accepted than are non-material items (e.g., operational skills in classifying objects). Experience with other projects suggests that even when all materials and equipment are supplied the innovation will not be taught by a substantial number of teachers. Even at the junior high school level, where the teacher's science knowledge and degree of specialization increases, Perkes'[2] study shows a failure to exploit materials provided, and failure to engage in inquiry methods of teaching. It is suggested according to the conceptualization of this study that teacher trainees and their functioning in groups will, through their interaction, improve the non-material aspect of the innovation -- their conceptualization and knowledge.

Eichholz[3] has postulated five reasons for the rejection of innovations: (1) ignorance, (2) failure of suspended judgment, (3) situational characteristics, (4) personal factors, and (5) experimenter's bias. Any single one of these factors or combination of them can block adoption to a greater or lesser extent.

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[1] Elihu Katz, Martin L. Levin, and Herbert Hamilton, "Traditions of Research on the Diffusion of Innovation," American Sociological Review, 28:244, April 1963.

[2] V. Perkes, "Junior High School Teacher Preparation, Teacher Behaviors and Student Achievement," doctoral dissertation, Stanford University, 1967.

[3] Gerhard C. Eichholz, "Why Do Teachers Reject Change?" Theory into Practice, 2:265, December 1963.

Ignorance is ruled out as a major factor here, since training was provided to all participants in the study. The lack of suspended judgment is extremely important. The teacher is likely to try out the innovation and then at the first discouragement, condemn it. The importance of suspended judgment lies in its provision for fair and adequate trial of the innovation. If the period of suspended judgment is too short, the first time the teacher has trouble with the innovation she may reject it. If she is at least committed to an extended period of suspended judgment, the likelihood of a fair trial for the innovation is increased.

Personal factors may very generally be considered as not easily changed, at least not by a very brief training program. The experimenter's bias is an effect which should be relatively well-distributed across subjects, considering the brief time of exposure during training and implementation phases. Effects of experimenter bias in interaction with participants would hopefully be eliminated as a major source of variance in output by the treatment design, which calls for the observers to be unaware of which dyads or isolates had a particular treatment.

This leaves situational characteristics. Situational rejection may be based on lack of materials (in this study they are being supplied), an already crowded schedule, a stand that what you have to offer is not better than the way it has always been done, or the argument that the program does not suit the children; it is intended that the program will cut into these sources of resistance. The extent to which the different training procedures reduce these factors is taken as a criterion.

Situational problems may cause trouble in other ways. The attitudes of colleagues, parents, the principal, the science supervisor, influential townspeople and students have their own impact on the innovation in a positive or negative fashion. Feedback from children may cause the teacher to feel that children become behavior problems when these materials are used. This aspect of the situation was tapped only through casual comments made in observer and investigator interviews.

Implementation of the innovation may result in child behavior which is different from that which the teacher customarily experiences in the classroom. Depending on the disposition and pre-preparation of the teacher, these cues may be considered as evidence of excitement, motivation, discovery, and learning; or they may be interpreted as a loss of order, lack of discipline, excitement leading to a chaotic situation which is not only out of control, but reflects negatively on the teacher's expertise.

CHAPTER II

PROCEDURES OF THE STUDY

The design of this study is a quasi-experimental one; the bases of the study are primarily theoretical, while the output desired is primarily an effective product operating in a natural setting. A consideration of Finan's[1] eight design options applicable to "problem-oriented" and "product-oriented" research shows that the present study bridges the two categories. Though the bases of the study are stated below as hypotheses, the design of the study does not provide sufficient control to allow attribution of effects to specific causes. The hypotheses in this study have been used as a basis for forecasting, and as a basis for *post hoc* interpretation of outcomes.

Two independent variables were employed. The primary independent variable had two conditions; (a) the group condition, which in this study was a dyadic group condition, and (b) the isolate condition. A secondary independent variable involved a variation in the training given to participants: this variable was also of two parts, (c) content only training, in which the participant had no explicit training in collaboration skills, and (d) content plus collaboration skill training. In the content only training condition a placebo of extended content training was employed so that training time for both groups are equivalent.

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[1] John L. Finan, "The System Concept as a Principle of Methodological Decision," in *Psychological Principles in System Development*, Robert M. Gagne (ed.), New York: Holt, Rinehart, and Winston, 1963, pp. 517-546.

The unit employed was an abbreviated version of the Material Objects unit developed by the Science Curriculum Improvement Study.[1] The teacher's guide used is reproduced in Appendix F. The investigator selected all material to be retained in the abbreviated teacher's guide. Twelve lessons are outlined, and detailed directions for implementation are provided.

Participating teachers were each provided with a kit of materials for use in their classes. Materials included in the kit corresponded to the materials listed for each lesson in the teacher's guide. Thus, any failure to implement could not be attributed to any lack of materials or directions.

One purpose of the study was to determine the effect that these independent variables may have had on the dependent variable which was the implementation of a new unit in elementary science. Criterion for implementation was a thirty-minute lesson, clearly related to the innovation, taught by a trainee, and observed by a project staff member.

Implementation was one of the three dependent variables. The development of productive groups was not left entirely to chance. The primary independent variable, group versus isolate, was split so that half of the participants in each condition received training in collaboration skills and the other portion did not. This led to a four-part design utilizing training conditions stated most simply as follows: (1) dyads with collaboration training, (2) dyads without collaboration training, (3) isolates with collaboration training, and (4) isolates without collaboration training. Content exposure and training time were held constant for all training conditions.

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[1] Material for the abbreviated version was adapted from the preliminary edition, published by D. C. Heath & Co., in 1966.

Random assignments to condition were made where this was possible. Certain restraints were placed on the investigator here, and these are detailed in Chapter 5. Random procedures used in this study were adapted from Edwards,[1] whose tables of random numbers were also used. A set of uniform plstic discs was numbered 00 through 39. A hole slightly larger than a disc was cut in the lid of a nearly cubical box. For any given selection, number discs corresponding to the possible number of alternatives were placed in the box, the box was shaken, and then inverted. The first disc which dropped out determined the number selected.

Assignments made at random included, in the following order: (1) assignment of the thirty project schools to dyad and isolate condition, (2) assignment of private schools in the isolate condition to content only and content plus collaboration skills training conditions, (3) assignment of private schools in the dyad condition to content only and content plus collaboration skills training, (4) assignment of public schools in the isolate condition to content only and content plus collaboration skills training, (5) assignment of public schools in the dyad condition to content only and content plus collaboration skills training, and finally (6) the assignment of teachers to be trained from those available in each of the thirty project schools.

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[1] Allen L. Edwards, Experimental Design in Psychological Research (New York: Holt, Rinehart and Winston, 1965), p. 100.

A dyad was defined operationally as two individuals randomly selected from the first-grade teachers available in a given school. A list of first-grade teachers available in the school was made in alphabetical order. From this list a random order list was made employing a table of random numbers.

The isolate was defined operationally as the only person from her school to be selected and trained in this program. She was the first person selected from a randomly ordered list of teachers available in her school.

Implementation was defined operationally as the teaching of an innovation-related lesson by a project teacher when she was observed by a project staff member. The investigator set criterion level for this lesson at 30 minutes. If a lesson of less than 30 minutes was taught, the lesson did not meet criterion, and was not considered implementation for purposes of this study. This criterion level was set because of the investigator's judgment that thirty minutes was an appropriate average time for a science lesson from the unit employed, and taught at the first-grade level.

To avoid last-minute problems with illness and absence of participants, one extra participant was chosen by the same random procedure in each school and designated an alternate in case the isolate or a dyad partner from any school was unable to attend during the first session. The alternate was to be employed if necessary only beginning at the first session. Any alternate so used was automatically to become the regular participant, and the absent teacher was to be dropped from the program.

As the training phase began, it became apparent that this replacement procedure was not necessary. Of the forty participants selected, all attended during the first session. The only change made during training was due to a death in the family of the participant (member of a dyad). At the second training session she was replaced by another teacher from her school, without the advice of the project. At that time the investigator had to decide to retain or eliminate the school, and decided on retention.

Selection of a Participant

A total of ten dyads, that is, twenty individuals, were selected in ten schools by the random procedure described above. Twenty isolates were selected randomly from their faculties in twenty schools. No more than one dyad or one isolate was selected from any given school. This precaution was taken to preclude confounding of results by the interaction of trained participants (1) in the dyad selection condition with any trained person except their dyad partner, and (2) in the isolate selection condition with any other trained person at all.

Description of the Project Schools

Thirty elementary schools were selected for participation in the study. All schools were located within the boundaries of one public school district. The locale was part of a large urban complex in the northeastern United States.

All public schools with first-grade classes in this district participated, a total of twenty-two schools. The remaining eight schools were selected from private schools which had expressed interest in the training program. Of the eight private schools, one was a Jewish day school and seven were Catholic day schools. All of the project schools had co-educational classes.

Description of the Teacher Population

Forty female first-grade teachers were selected for the study. Table 1 on page 33 provides a description of the population of teachers. Of the forty, twenty-eight were teaching in public and twelve in private church schools. Of the twelve teachers from religious schools, there were seven secular and five lay teachers. In some schools only the required number of teachers were available; in others some selection had to be made, and this was done randomly.

For each of the four treatment conditions, means are given for both total years teaching experience and age at start of program. A breakdown is given to show public and parochial teachers per treatment condition.

Considering the relatively small number (ten) of subjects in each treatment condition, a frequency distribution may provide more information at this point. Figures 2 and 3 on page 34 provide these distributions for teaching experience and age, respectively.

The investigator was concerned in this study with meeting at least minimal requirements for good experimental design by randomly selecting participants from those teachers available in each project school, and then randomly assigning teachers selected by this process to one of the four treatment conditions. This selection and assignment procedure should eliminate any systematic selection bias on the part of the investigator, and hopefully reduce to non-significant levels the probabilities that the four treatment conditions differed from one another in relation to either age of participants or the total teaching experience of participants.

Tests of mean difference were performed on the four treatment conditions to test the two null hypotheses that (a) the four treatment conditions do not vary significantly in relation to the teachers' total years teaching experience, and (b) the four treatment conditions do not vary significantly in relation to the teachers' ages. F values of 0.79 and 0.66, respectively, were obtained. Values of 8.61 are required to reject the null hypothesis in these comparisons with an alpha = .05. Therefore, the null hypotheses can be accepted and the four treatment conditions may, for the purposes of this study, be considered to not vary significantly in relation to either the ages or the total experience levels of the teachers assigned to them.

Some comment regarding the allocation of teachers from public and private sectors to the four treatment conditions is called for here. Though each condition contains equal numbers of teachers, the ratio of private to public teachers is not the same. Specifically, the ratio is 0.4 in the two dyad conditions, and 0.2 in the two isolate conditions. The decision problem here is explained in Chapter 2. The investigator's choice was between placing a greater number of parochial teachers in either the dyad or the isolate condition. The choice made was based upon the investigator's major interest in the group variable. Limitations incurred by this choice are discussed in Chapter 5.

TREATMENT CONDITION	N TEACHERS	N DYADS	TOTAL YEARS TEACHING EXPERIENCE	AGE IN YEARS-MONTHS AT START OF PROGRAM	TEACHERS/TYPE OF SCHOOL	
					PUBLIC	RELIGIOUS
1. DYADS: CONTENT AND COL-LABORATION SKILLS	10	5	12.45 $\sigma = 6.77$	40 - 9* $\sigma = 12.78$	6	4 (3 secular, 1 lay)
2. DYADS: CONTENT ONLY	10	5	15.45 $\sigma = 12.73$	42 - 9* $\sigma = 12.58$	6	4 (2 secular, 2 lay)
3. ISOLATES: CONTENT AND COL-LABORATION SKILLS	10	0	12.00 $\sigma = 11.25$	43 - 2 $\sigma = 13.57$	8	2 (2 lay)
4. ISOLATES: CONTENT ONLY	10	0	8.45 $\sigma = 6.35$	35 - 10 $\sigma = 10.53$	8	2 (2 secular)
	40	10	F = 0.77	F = 0.66	28	12

TABLE 1. DESCRIPTION OF THE TEACHER POPULATION

*One participant excluded.

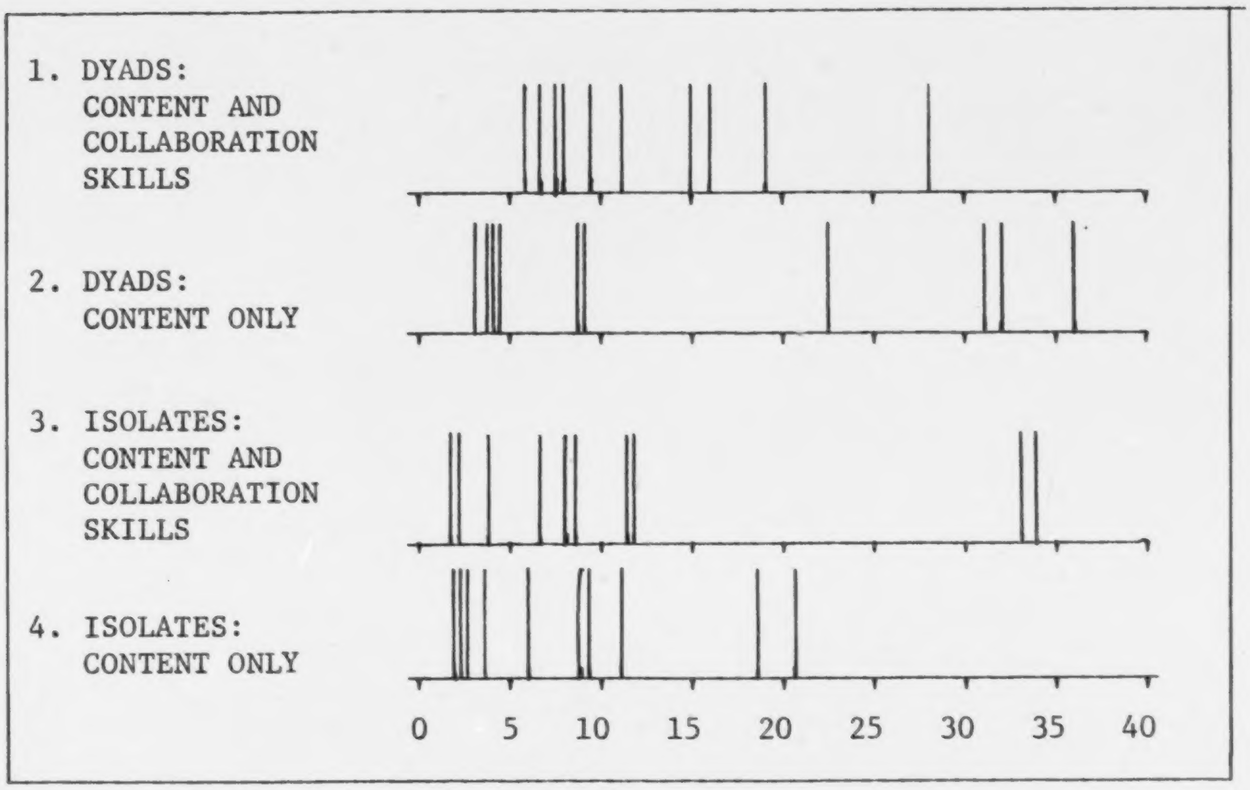

FIGURE 2. TEACHING EXPERIENCE (YEARS)

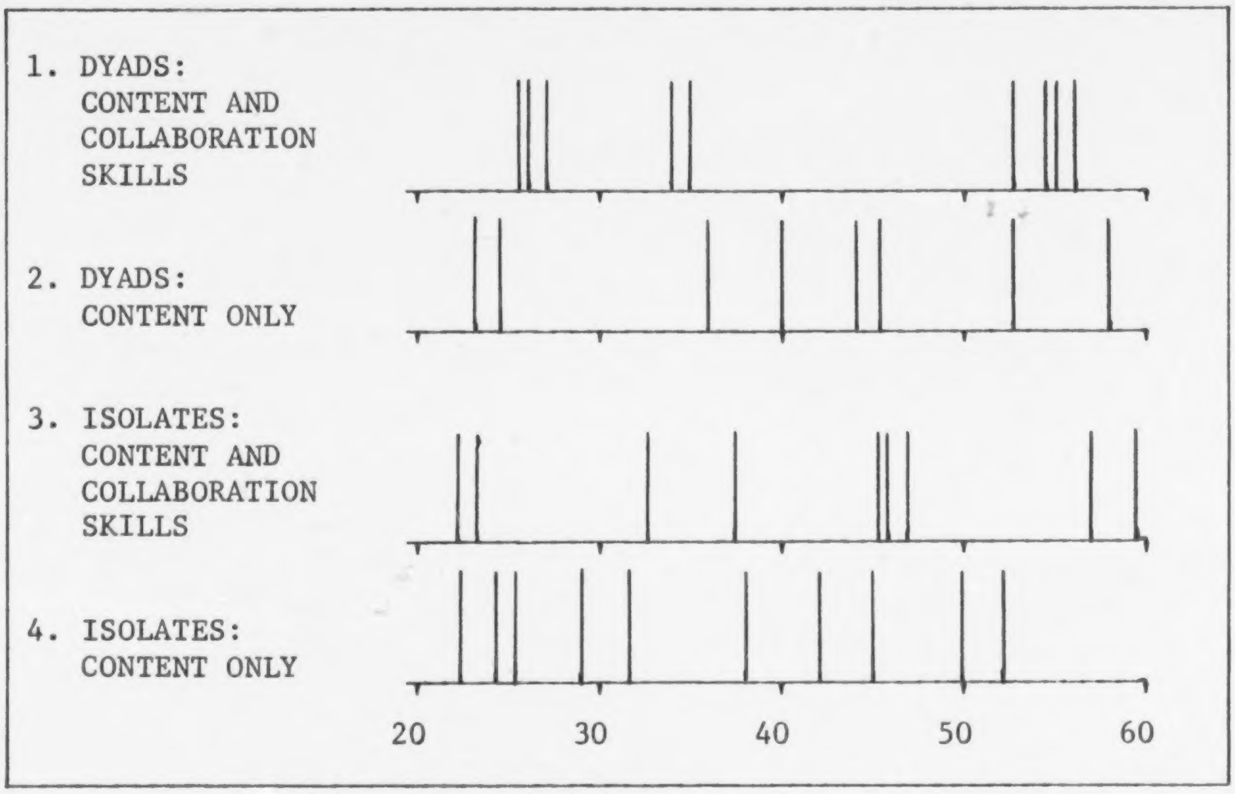

FIGURE 3. TEACHER AGES

Training Program

During training all participants worked as members of a dyad. Natural dyads from the schools were retained for purposes of training. Natural isolates were assigned an isolate as a dyad partner for the duration of training. Assignment to dyads of the isolates was determined by seats selected at the first training session. Adjacent isolates became partners for training, and remained with the same partner for each of the three sessions.

Training in the philosophy and content of the unit was given in three two-hour sessions, for a total of six hours. Training time was controlled for all treatment conditions. One two-hour session was held each week for three consecutive weeks. Each session was split into three parts: (1) an initial thirty-minute portion, discursive in character, regarding the philosophy of the program and some attitudes which may be useful in teaching the unit; (2) a one-hour exploratory and experimental session during which the dyads observed objects to be used with the unit, discovered some relations among these objects, and carried out experiments with the objects in order to find out more about them. Each teacher was allowed to keep notes of her observations, experiments carried out, and findings of those experiments; (3) a thirty-minute session devoted to activities designed to promote collaboration skills. This third division was used with half of the dyads and half of the isolates. The other half of both dyads and isolates had Part Two continued for thirty minutes, and for them Part Three was dropped.

All participants were trained by the investigator for the six-hour program. Training for isolates and dyads was identical. This was guaranteed insofar as was possible by the trainer following a script which outlined all topics to be covered in detail.

An outline agenda for the training program is presented in Figure 2 on page 37.

Observer Training

Three paid observers were obtained through the assistance of a professor at a university adjacent to the experimental school district. Two observers were female, one male. All three had extensive experience in teaching and supervision, and were retired from the New York City school system. All three were currently engaged in supervising practice teachers for their university. Attempts to obtain additional observers met with no success.

One two-hour training session was held with the three observers. Prior to the session, the investigator asked each observer to read and become familiar with the teacher's guide for the study. Observers were given the observation form and each item was explained by the investigator. Observers were asked to provide information regarding what was actually going on in the classroom, and how the observer felt about it. At that time this category was considered peripheral by the investigator, though later he became aware that this category could have been pivotal for the success of the study. The investigator suggested the following as being appropriate for comment by observers: (1) grouping of children for a lesson, (2) movement of children and the teacher during the lesson, (3) teacher-questioning procedures -- e.g., convergent, divergent, rhetorical, (4) approximate ratio of teacher-talk to child-talk, (5) wait time after teacher question.

SESSION	CONTENT	TIME
1	Role of the teacher as observer. Learning how to observe, remain silent, encourage child-materials and child-child interaction.	30 min.
	An operational definition of "object" considered by the group. Objects in the classroom. Air, water, plants and people as objects. Teachers take home task of defining "object."	60 min.
	*Working with partner, make a list of ten objects in the workshop room. Must both agree. Then discuss process by which you reached decisions; consensus? influence? disagreement?	30 min.
2	Continue discussion on definition of "object," arrive at agreement on definition. Discuss last week's session, difficulties experienced.	30 min.
	Develop qualitative tests for identification of a series of pure "mystery" (unknown) powders. Then determine composition of mixtures by using these tests.	60 min.
	*How do you feel about what we discussed last week? Introduce task. Then discuss -- trust, openness, and competitiveness (inside pair and between pairs). What did you say to another person about what happened last time, that you did not say to your partner last time?	30 min.
3	Structure of the Science Curriculum Improvement Study. Structure of the Material Objects unit	30 min.
	Electrical interaction. Creation of systems with specified numbers of components to demonstrate a variety of evidences of interaction. Use of batteries, bulbs, wires, and clips.	60 min.
	*Between partners discuss; what three problems do I pose for you? What three problems do you pose for me? (in relation to work on the task) What is the likely impact of problems we have on the children we teach?	30 min.
	Total Time:	6 hours

FIGURE 4

OUTLINE AGENDA FOR THE TWO PARALLEL TRAINING PROGRAMS:

*Sections preceded by an asterisk (*) are used only in content plus collaboration skills training; in content only training Part Two of each session is extended so that the total time for both programs is the same.

The observers and the investigator then used the observation form to describe a twenty-one minute video-taped lesson involving the sorting of buttons. Comments given by the observers in these descriptions were so similar that the investigator felt further training was not necessary. Subsequent differences in the reports of observers, in terms of objectivity, variety of commentary, fidelity with the observation format and directions of the investigator, and quantity of commentary produced, made it amply clear to the investigator that much more attention should have been given to observer training. Observers were directed to mail in their reports on the same day that they were made.

During the second week of observations (implementation phase) the reports of one observer were found to differ radically from the training model. There was also a long time-lag in mailing of reports by observers. By this time the investigator had gained enough experience to feel that certain more specific information from the observer might be useful. The observers were called together for a second two-hour training session.

At the second session an S.C.I.S. film on observing liquids was shown, and observation forms were completed by the observers. Again, the similarity of responses of observers was great, with the exception that one observer left out "time taught," the criterion indicator for implementation. Observers were then asked to supply the following specifics in their observations: (1) the exact racial mix -- black, white, Puerto Rican, Oriental; (2) the number of children who a) interact with the teacher, b) interact with other children, c) cause discipline problems, d) appear to be "out of it," e) appear to be "with it"; (3) specific examples of child-child and child-teacher interactions, using accurate wording; (4) how the lesson structure is determined -- e.g., a) does the teacher allow children to select properties to be examined, or give children specific properties to look for, and b) how much prompting is going on. Again, observers were asked to be sure that their reports were mailed on the same day that the observation was made.

Outcomes from this second session were mixed. One observer carefully answered each item for each observation. Two observers answered some of the items each time, but not all of the items each time. One observer continued to file reports erratically, sometimes on time, mostly late.

Implementation

Implementation of the innovation by teachers was determined by an actual count of minutes taught in an innovation-related lesson. Criterion level for implementation was 30 minutes. A time of less than 30 minutes was not counted as implementation. The tally was made by a trained observer in the classroom.

This last phase of the study commenced the first week after training and continued for eight weeks. Four weeks would have been sufficient for the implementation phase had no vacations intervened, had the observers been free to go to the schools every day, and had the teachers been free to be observed at any time. All three difficulties arose while the study was in progress. Every attempt was made to compress the observation schedule as closely as possible to the originally planned four weeks; had it not been for these efforts, the implementation phase would have lasted at least another two weeks.

Each teacher was observed individually once each week for four weeks. A schedule was set up in advance with the teacher, and she knew in advance the exact time at which each observation would take place. On each observation visit the observer arrived and departed according to schedule, and was directed to discuss only specific questions that he or she must ask the teacher. The observers noted any interaction which took place between them and the teacher, outside asking and answering of the required questions.

Teachers were advised that all observations would be held in the strictest confidence by members of the study and would be used only for experimental purposes. They were also told that they would receive a summary report at the end of the program.

Data forms which the observers used during their observations are discussed below under "Instruments."

Instruments

Five types of instruments were employed in this study. The first of these was an observation form which was filled out by the trained observer each time he or she visited a classroom. The second was a semantic differential instrument following the technique developed by Osgood,[1] and was completed by all participants at three stages in the study. The semantic differential was introduced as a measure which may be useful in clarifying how the participant regards the innovation before training, after training, and at the end of the implementation period.

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[1] Charles E. Osgood, George J. Suci, and Percy H. Tannenbaum, The Measurement of Meaning (Urbana, Illinois: University of Illinois Press, 1957), pp. 76-124.

The semantic differential is therefore a measure of shifts in the attitudes of participants toward the innovation, and may be crucial in interpreting the relationship between the independent variables and implementation. The third instrument was a brief personal information sheet to be filled out by each participant. The fourth instrument was a dyad growth instrument which was administered twice to those teachers who received communication and collaboration skill practice. The fifth instrument was a follow-up sheet. This instrument was designed to allow teachers a chance to express their feelings about the program at the end of the observation phase, and also served as a check against observer reports.

Observation Form

This form was designed for use by the trained observer, and contains indicators of the dependent variable, implementation. The instrument is reproduced as Appendix A on pages 125-126.

Each observer was directed to record his time of entry and leaving a specified teacher's classroom on a specified date. He recorded also the exact number of minutes he was present when the teacher was giving a lesson directly suggested by the innovation. The observer was unaware of the 30-minute criterion level for implementation set by the investigator.

Materials observed to be in use during the lesson were listed in the greatest possible detail by the observer.

The observer then noted any further information which he felt might help clarify what was going on during the lesson, including any comments or questions which the teacher directed to him, and answers or comments which he made to the teacher.

At the beginning or conclusion of each visit the observer asked the teacher the following questions and entered responses on the form:

For Dyads: (1) How many minutes have you spent discussing the innovation with your partner in the last week?, (2) With whom else have you discussed the innovation in the last week, and for how many minutes with each person?, (3) How much time have you spent in preparing to teach the innovation in the last week, in minutes?, (4) How much time have you spent teaching the innovation when I was present?

For Isolates: (1) With whom have you discussed the innovation in the last week, and for how many minutes with each person?, (2) How much time have you spent in preparing to teach the innovation in the last week, in minutes?, (3) How much time have you spent in teaching the innovation when an observer was not present?

Semantic Differential

The instrument used here was developed by the investigator for the present study. Concepts used were selected to tap the way each respondent felt at a given time about (1) elementary science in general, (2) the Science Curriculum Improvement Study materials in particular, (3) how the Science Curriculum Improvement Study materials appear to children. The complete instrument is reproduced in Appendix B on pages 127-130.

Adjective pairs employed were chosen specifically for their content relevance, that is, the positive poles are adjectives which have been used to describe the program and materials developed by the Science Curriculum Improvement Study. Many of these adjectives were taken from several papers written by the Director of S.C.I.S., Dr. Robert Karplus.[1]

Validity of the scales in predicting differences between S.C.I.S. and elementary science in general was determined by giving the instrument to persons trained by S.C.I.S. and asking them to respond. Large differences in item (concept x scale) ratings between the concepts "How Teachers Feel about S.C.I.S. and "How Teachers Feel about Elementary Science" were taken as indicating discriminating scales. At the second phase of validity checking, the instrument was rated by persons unfamiliar with S.C.I.S., yielding very small differences. This validation phase of the instrument development was carried out with a population of T's who were not a part of this study.

Figure 5 on page 44 summarizes the phases of the study, giving points at which each of the measures was applied.

Personal Information Sheet

Certain personal variables, such as teacher age, experience at various grade levels, and spare-time interests may be related to the implementation behavior of the individual teacher, and were collected on a brief questionnaire at the beginning of the program. This information was collected as a precautionary measure. The questionnaire is included on page 131 as Appendix C.

Dyad Growth Instrument

Half of all participants were trained in the use of techniques designed to enhance their communication and collaboration skills in the dyad. This training is described in Chapter III. An instrument devel-

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[1] Robert Karplus, Theoretical Background of the Science Curriculum Improvement Study (Berkeley, Calif.: Science Curriculum Improvement Study, no date).

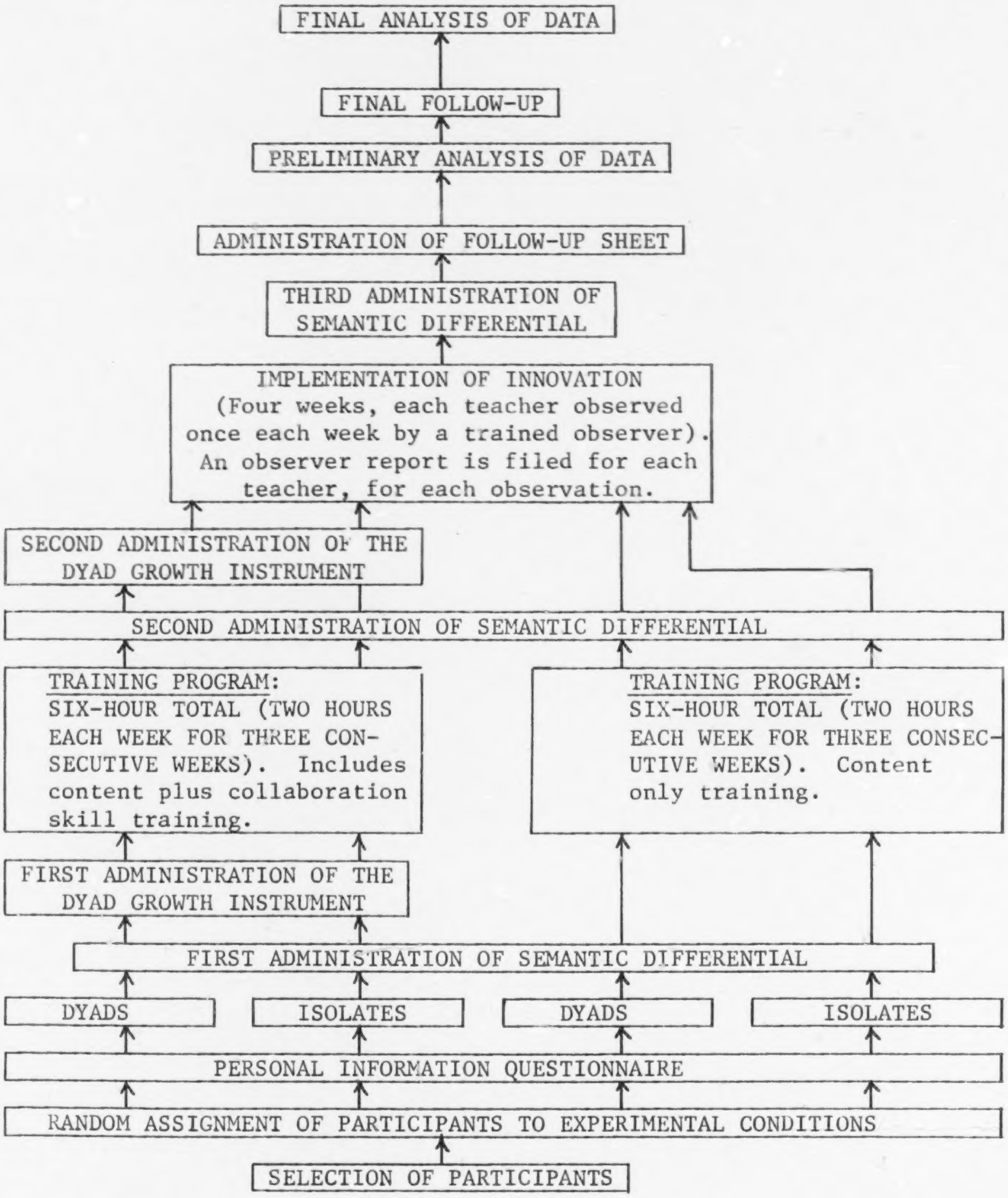
FINAL ANALYSIS OF DATA
FINAL FOLLOW-UP
PRELIMINARY ANALYSIS OF DATA
ADMINISTRATION OF FOLLOW-UP SHEET
THIRD ADMINISTRATION OF SEMANTIC DIFFERENTIAL
IMPLEMENTATION OF INNOVATION (Four weeks, each teacher observed once each week by a trained observer). An observer report is filed for each teacher, for each observation.
SECOND ADMINISTRATION OF THE DYAD GROWTH INSTRUMENT
SECOND ADMINISTRATION OF SEMANTIC DIFFERENTIAL
TRAINING PROGRAM: SIX-HOUR TOTAL (TWO HOURS EACH WEEK FOR THREE CONSECUTIVE WEEKS). Includes content plus collaboration skill training.
TRAINING PROGRAM: SIX-HOUR TOTAL (TWO HOURS EACH WEEK FOR THREE CONSECUTIVE WEEKS). Content only training.
FIRST ADMINISTRATION OF THE DYAD GROWTH INSTRUMENT
FIRST ADMINISTRATION OF SEMANTIC DIFFERENTIAL
DYADS
ISOLATES
DYADS
ISOLATES
PERSONAL INFORMATION QUESTIONNAIRE
RANDOM ASSIGNMENT OF PARTICIPANTS TO EXPERIMENTAL CONDITIONS
SELECTION OF PARTICIPANTS

FIGURE 5

PHASES OF THE STUDY, SHOWING ADMINISTRATION OF ALL MEASURES oped by Howard Williams, Billy Alban, and Charles Seashore was modified for use in this study, and was given before training and at the end of training. The instrument contains nine five-point scales, each of which relates to the way in which a person feels about certain process goals or needs in the dyad. The instrument is reproduced on pages 132 and 133 as Appendix D.

Shifts in scale ratings on this instrument should indicate any change in the feeling of pair partners regarding process goals in the dyad.

Follow-Up Sheet

The follow-up sheet is reproduced on pages 134 and 136 as Appendix E. Several problems which arose during the study led to the development and administration of this instrument. Certain teachers said that they hoped they would have a chance to offer their personal feelings about the program at its conclusion. The investigator found that vital data was missing from certain observation reports, especially data involving the dependent variable, implementation.

An excellent opportunity for the administration of the instrument was offered when the district science consultant called for two voluntary follow-up sessions which were held after completion of the study. Half of the teachers attended these voluntary sessions. Forms were mailed to those not in attendance.

Items included on the instrument fall into three categories. The first included an attempted corroboration of observer reports, with items on (a) minutes taught, not observed; (b) times taught per week; (c) minutes taught per lesson; and (d) preparation time per week. The second related to the teacher's experiences with the innovation, and asked about

(a) the response of her students to the unit, (b) her willingness to teach the unit again next year, (c) materials which require replacement, (d) the response of other teachers in her school, (e) changes she would suggest in the lessons, and (f) her overall feelings about the project. The third simply listed the twelve lessons covered by the teacher's manual and asked the teacher to check the activities she had taught.

CHAPTER III

TRAINING PROGRAM

Teachers trained for this study attended three training sessions. Each session lasted for two hours, were held from 3:30 p.m. until 5:30 p.m., and were spaced at one week intervals. Twenty teachers attended on Tuesdays and twenty other teachers on Wednesdays. Tuesday sessions introduced the philosophy of the science unit to be taught, and the investigator sought to provide a teaching model consistent with this philosophy by establishing work groups and carrying the trainees through three separate open-ended inquiries in science. The content of the first inquiry was identical with one segment of the science unit being introduced, while the content of the second and third inquiries was not directly related to the innovation. The investigator selected training items which were not directly related to the innovation as a way of increasing the likelihood that implementation, a dependent variable, might be related to selection condition (isolate or dyad) and training condition (content only, or content plus collaboration skill practice), both of which were independent variables in this study. Had the trainees been exposed only to content directly related to the innovation, teaching of the innovation could have been limited to activities experienced by the teacher in training.

Wednesday sessions included the same science experiences as the Tuesday sessions, though certain tasks and discussions were structured in such a way that the trainees considered their interpersonal relations within the dyad, especially as regards decision-making. This emphasis on what the investigator is calling communication and collaboration skill practice existed within the context of the science innovation employed. Working the collaboration skill practice segment in with the science skills taught was essential to the investigator as he was attempting to closely link the teaching of the innovation with the utilization of a pair partner for purposes of comparison and support in the face of influences potentially hostile to implementation of the innovation in the back-home situation.

Below is a description of the complete training program. Appendix G on pages 166 through 204 consists of type scripts from tapes of the second and third Tuesday sessions, which dealt only with the content and philosophy of the science unit introduced. Appendix H, pages 205 through 246 includes parallel type scripts for the Wednesday sessions, which included in addition skill practice in collaboration within the dyad. Tapes were not made of the first session in either the Tuesday or the Wednesday series.

Tuesday Sessions: Including Philosophy and Content of the New Science Unit

First Session

The first order of business was to make sure that all isolates had a partner. As none of the isolates knew any other isolate, those sitting closest together at session one became partners. We then went directly into a consideration of objects and non-objects. No definition of the term object was offered by the investigator. He did invite definitions of the term from the participants. Most of this session was devoted to considering whether or not we should consider water (liquid), ice (solid), air (gas), plants (living organisms), and persons to be objects. No closure was achieved through defining "object," or by distinguishing between objects and non-objects so far as the group at large was concerned. Many teachers went away wondering, and all were asked to make a decision for themselves regarding the distinctions between objects and non-objects by the time we met the following week.

Second Session

During this session we had to deal with the terms "object" and "property." The meanings of the terms were discussed at length. Some excerpts from the tapescripts serve to illustrate: "An object, what's an object? An object is something that has properties. I don't mean to be redundant, but properties are those words which describe attributes we can see, hear, taste, smell, or touch." "[One] can say that an object is red, or that it's hard, or that it's soft, or that it's rough, or that it's bumpy, or that it's wet, or dry, or sticky. These are all properties. And if an object has any one of these, then it's an object...."[1]

There were many digressions, mostly dealing with ramifications of precisely defining objects. We got into phases of matter, multiple meanings of words, verbal and non-verbal feedback we provide for students.

Our inquiry for this session was to observe five "pure" powders and experiment with them using means such as mixing with water, vinegar, or iodine solution, and heating. Information gained here was then applied to the problem of identifying several unknown powders, several of which were mixtures. Teachers were asked to identify the components of the unknowns, and estimate the relative amounts of each powder present in the unknown.

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[1] Appendix G, p. 169.

"...we have five powders, o.k.? These are not mixtures. You will want to observe these powders, find out what they're like." "Now when you have decided on properties, be sure to write them down somewhere."

"Will we die if we taste?"

"You can taste objects. However, I would suggest that perhaps tasting is one of the less preferred techniques for getting information." "[Children are] willing to taste practically anything, and so what I would suggest is that it might be a rather dangerous concept for us to be putting across -- tasting as a way of getting information."[1]

Third Session

Much of session three was devoted to procedural matters such as who are the observers to be? When can the observer expect you to teach a lesson? When will you find out your observation schedule; how much time you should spend teaching, and whether or not teachers must make lesson plans for the observer.

The investigator's expectations of time to be spent in teaching were gotten across in the following exchange. "What would be the ideal objective of what time -- how long -- how many weeks would be the ideal objective to complete these twelve lessons?", a teacher asks.

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[1] Appendix G, p. 181.

"I'll give you my estimate, and it probably won't work for anyone in the room. But my estimate is that if you pace the material even fairly rapidly -- it would take you six weeks. If you drag it out, which is what I would do, with a lot of practice, then it might take you several months."

"How much time should we teach each day?"

"I'm estimating there anywhere between an hour and two hours a week -- totally."[1]

Another procedural item important to the teachers was their freedom to vary lesson plans printed in the Teacher's Guide. A teacher asks, "Now we can embellish, change, relate, or not relate, or leave out?"

"That's your prerogative as a teacher."

"Something to the effect that this is your lesson plan but she can change it?"

"Absolutely."

"Can I do the same lesson twice?"

"These are guidelines, aren't they?"

"They're guidelines, and they're really a way of giving you a few ideas about how to begin to approach the lesson, what to do, what to look for, what materials to use."

"So should we stick to the general outline?"

"There are no prescriptions. And you don't have to stick to lesson one, lesson two. And if you find it's a little slow going to begin with, well, take your time. There's no rush."[2]

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[1] Appendix G, p. 189.

[2] Ibid.

Later on we got into the business of what is an object and what is a property again. Then the investigator invented the term "system" for the teachers, and led into a consideration of an object collection closed inside a paper bag. At first the emphasis was on evidence, and the kinds of evidence we are able to collect as a basis for inference regarding the contents of the bag.

When the bag is rolled up, and fastened with a rubber band we have certain evidence available. When the band is removed, and the bag is stretched out we have other evidence, perhaps more evidence. When the bag is opened, and the objects dumped out we have other evidence. And when we interact, certain of these objects with one another, we may obtain evidence which will serve as a basis for another level of inference regarding the properties of these objects.

One exchange serves to identify the investigator's emphasis on properties: "So your possibilities for interpretation are extended a little more when the bag is.... How about when you dumped all the objects out on the table? Then what?"

"It was obvious."

"What was obvious?"

"The things that were in it."

"There were some objects that we didn't know the names of. We didn't know the name of a clip. Even when we saw this thing we didn't know what it was."

"Can you describe it for us?"

"It feels -- I knew exactly what it felt like in the bag."

"How did it feel when it was in the bag?"

"It felt like a cylinder on two sides, and flat on one side, and I felt that there were projections on the ends. And sometimes we felt the wires, sometimes we didn't feel the wires."

"What more do you know about the object now?"

"I don't know anything more about the object except that it's made in Canada. I don't know this object."

"O.K."

"The color, you can identify the color now."

"So you are still faced with the basic problem here that it is not a familiar object to you and that you're able to find out some more properties of the object. And you're able to describe the object even though you don't know what it is. And actually if we were to pass the object to someone else, what's the likelihood that they would be able to come up with fairly much the same properties? See what I mean? In other words, the properties, among people of our particular level of experience are not going to vary too much. Uses here are names for the object which might vary tremendously with our experience. The shape of the object -- some of its basic properties such as having wires sticking out of it, one red, one blue, having a brown case, having a little something or other sticking out of the end and it turns. These properties are not going to change too much and so this gives us some sort of meeting ground, let's say, in terms of communication."[1]

During the remainder of the session the pairs worked on tasks such as lighting one bulb, lighting two bulbs, and inventing systems in which they observed different evidences of interaction. There were still more questions of a procedural nature at the end of this final session in the Tuesday series of three.

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[1] Appendix G, p. 201.

Wednesday Sessions: Including Philosophy and Content of the New Science Unit, and Procedures Designated by the Investigator as Collaboration Skill Practice

First Session

During the first meeting of this series the content covered closely paralleled the first session of the Tuesday series. The science content followed the theme of activities 1, 2 and 4 found in the Teacher's Guide, Appendix F to this report. Essentially, the teachers were invited to define the term "object," and properties (attributes of objects perceived through the senses) were used as a basis for arriving at some adequate definition.

Most of the first hour, after disposing of some completion of forms, was devoted to a comparison of points of view among the teachers. The investigator assumed the role of discussion leader, and asked whether or not the teachers would consider this or that (e.g., a plant, an ice cube, water in a dish, air in a plastic bag) an object; if so, why? If not, why not?

During the second hour of this session pairs were charged with the task of coming up with a list of ten objects, together with their properties. They were advised that they must achieve consensus on their ten choices.

After 15 minutes the dyads reported back. Their reports took about twenty minutes. The investigator then introduced the idea that three factors might enter into decisions made within the dyad. These factors were (1) trust, (2) openness, and (3) competence. Trust was defined as just how much information a person is willing to share with his partner. Openness was defined as not holding back information, whatever the reasons one might want to hold it back. Competence was defined as the teacher's perception of her own ability to deal with the subject at hand, or conversely, her partner's ability to do the same.

Participants were then asked to consider their own decision making process in terms of these three factors. How did each of these factors affect the decisions which led to the completed list of ten objects? In the reporting back all pairs agreed that the factors either had no relevance in their decision making, or at least had caused no problems. One pair insisted that they had "known each other for years," and so how could they have any difficulties coming to consensus? The idea was offered by several teachers that these decisions regarding objects were no problem in relation to the three factors, as they simply search for objects which would create no problems for either members of the dyad. It was also suggested that if the decision had been a more thorny one, partners might have had a more difficult time in achieving consensus. In other words, the decision regarding object or non-object was no problem for the dyads.

Second Session

This session, like its counterpart in the Tuesday series, dealt primarily with inquiries into the properties of various pure powders. Information gained was then used to determine the composition of several unknowns, which were actually mixtures of two or more of the five pure substances first presented.

During this session the investigator asked the teachers how they felt about what had been done during the previous session, and specified "...what do you think as an individual, as a member of a pair, as a member of a workshop, about some of the ideas and some of the questions that were put across last week?"[1]

After a few comments about trying out their experiences on friends at home and school several rather open comments followed, e.g., "Are you testing us or what?," "Well, it's sort of almost like a psychoanalysis type of thing -- how were we reacting to your....?, "...I don't feel that last week we learned too much about science. I think that we were being researched...."[2]

The intent of the investigator's probe had been to bring the teachers' feelings about trust, openness, and competence to the surface. However, his request was accepted literally and several important procedural comments came up. "Um, I felt that -- um -- you really wanted to stress procedure rather than something definite that we could teach in science -- a way of the children discovering things which we have not done up to now -- I mean, I can't speak for everyone,"[3] and then "I just want to comment on something that she said -- procedure, as if you gave us the idea of objects just by throwing it out to us and letting us discover it, whereas this is what we should try for with the children -- let them experiment on their own instead of telling them what it is. This is the way I felt."[1]

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[1] Appendix H, p. 205.

[2] *Ibid.*, p. 206.

[3] *Ibid.*

Another lady got the message as I had intended, but seemed confused. "...one of the things that really stuck in my mind -- how did I feel about my partner?" "I could never get it through my mind exactly why you asked me about my partner, because first thing that came to my mind because you said 'How do you see your partner?' And the first thing that went through my mind was, you know, 40-40 vision." "And I kept saying, maybe I'm a little dumb or something, because everybody else was coming up with all these nice answers. And I really had not been so involved in what was going on that I had really given a thought one way or the other."[2]

Comments concerning procedures were made again and again, and on several occasions the investigator tried to bring the direction of the session around to interpersonal process. He finally said, "I'd like to get back onto the process track -- the process track in the sense that I would like you to go back to thinking about the question I just asked in which I got one response to and after that we got side tracked again. I wonder why we keep getting side tracked when we come to that question?"[3]

Only a few comments were generated by this statement, and the investigator went into a summary of his reasons for considering trust, openness, and competence using one teacher's statement as a lead. She said, "I was surprised that you raised that question of trust and confidence in a partner at the time that you did within the framework that you did it and I wondered what your real purpose was."

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[1] Appendix H, p. 207.

[2] _Ibid_.

[3] _Ibid_., p. 212.

And the response, "Yeah, well, I really wanted you to think about it, that was my purpose. Actually -- you know it just may be that there are certain considerations that are sort of taboo in certain relationships between people. And we were just talking about this a moment ago when we were chatting about these words; we were saying -- "Well, you know, I feel that this is a professional level of work, we're not concerned with these things here. We're concerned with learning some content in teaching, teaching method and so on. So what's this all about? Here you're introducing something which gets pretty darned personal you know, and even though it may be irrelevant here, I can see a situation in which maybe it wouldn't be so irrelevant and I'm not sure I want to answer you on that, o.k.? If the situation were changed I'm not sure I want to really talk about that. Suppose we have a tough thing to do here, it wasn't just finding a few objects; suppose we had a really tough decision to make and I had to evaluate my partner on those three and we had to show each other our answers. How would I feel about that?" Now several of the comments that have been made today have already led me to believe that several people were perhaps thinking, you know, perhaps thinking "irrelevant," or perhaps thinking "well, what the heck is he asking this kind of a question for because after all we're operating at this level and he's digging somewhere value ________ and I don't exactly like that." Now the reason I'm asking you how you feel is because maybe feeling is a little different than analyzing very much and so on. Feeling is perhaps a little more, well, oh, well, it's a little more messy let's say than operating on a subjective level on which we operate on most of the time. Analysis, objectivity. Feeling is a lot harder, it's a little harder to put into nice little packets."[1]

After this statement the session went back to a consideration of the unknown powders, and did not return to group process.

Third Session

During this last session the science content dealt with the major concepts of the first three years of the S.C.I.S. materials in physical science, and an inquiry into systems constructed from objects placed in a closed paper bag given to each training dyad. Contents of this bag included objects which might generally be considered electrical or magnetic, e.g., compass, magnets, wires, motor, socket, and bulbs.

Group process considerations centered on competition, both within dyads and between dyads in the training situation. Teachers were asked to "...consider the object in front of you a system if you will. You may not open it but I would like for you, with your partner [to find out how many objects are in the system and try to decide what they are]." "We don't want any particular sharing of information except with your partner. Do not collaborate with the other two at your table."[2]

After a brief period of examining the bag, which was rolled up and held by a rubber band, we went around the group collecting number estimates and object name predictions or property descriptions. Then the task was changed a bit; "You may take the rubber band off and you may stretch out the bag but you may not look inside. Be sure to keep the end from coming open. Be sure to keep your neighbor from seeing inside your bag."[1]

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[1] Appendix H, p. 214.

[2] Ibid., p. 232.

Teachers were then asked to revise their number and properties predictions or descriptions if this was required, and we went around again, this time giving revised estimates, and describing changes made as a result of new information gained. After this round the bags were opened and the contents dumped out on the table.

The next task was "...for each pair without sharing information with anyone else except your partner, ...to invent six systems which have to be different in the objects they contain, and which have to interact in some way so that you will see a change take place in the system."[2] After a period of experimentation, pairs reported their findings to the group at large.

Next the pairs were asked to reflect on their interpersonal process. "I would like you and your partner -- going back to something that we discussed some time ago -- to spend between about two to three minutes, and I will time this, discussing any relevance that these three concepts may have to the decisions that you made at your table is apparent to the system, the systems that you found today. I would like to recall our previous discussion about some of the aspects of interaction between people, specifically, and how people communicate with one another. And I would like you to think about an aspect of human interaction which is called competition or competitiveness and I would like you to think of this in terms of both of you and your partner together, and you and your partner as opposed to the people across the table from you, or other pairs in the group. In other words, what relationship might competitiveness have to decisions that you will make about systems that you will define; let's say -- originality of the systems that you pick, or similarity to systems you pick in relation to other people's systems. So, in other words, just think about this term, and also two very personal aspects of interaction between you and your partner. Again going back to the aspect that we will call trust. In other words, how much information are you willing to share with your partner, how much information is your partner willing to share with you, and does this go cross-pairs or is it just within the pairs? O.K.? And the third one is openness. That is, is there anything that you would not share with your partner or with someone else in the group about the systems that we're defining? Just how open are you in sharing information? Do you feel that there is any likelihood that you might hold anything back? Or that you would tell us all about what you see in the system? Three minutes."[1]

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[1] Appendix H, p. 235.

[2] Ibid., p. 237.

Teachers were then asked to report their perceptions regarding competition, trust, and openness. "O.K. now, I would like to ask each pair to tell us very briefly how you feel; I'd like each pair to tell us very briefly in a few words about how they perceived these items: competition, trust, openness -- in terms of the past day and whether or not they perceive any changes in relation, let's say, to the three sessions in which we've been operating."[1]

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[1] Appendix H, p. 241.

The following reports showed that many of the teachers had zeroed in on openness, trust, and competitiveness. The following run of comments illustrates these perceptions:

Teacher: "As far as competition there was no competition, that is, we were that way because we wanted to do as well as each group and you asked that we do six systems and we wanted to make sure that we did six or more, if possible. As far as trust, we've had all the trust, we've been willing to share, and we haven't had any problems with that at all. As far as openness with each other, we've had that as far as the table. Because when their bulb lit, we certainly were trying and they wouldn't show us."

Investigator: "Good for them."

Teacher: "We had to figure that out ourselves."

Teacher: "Yours did, and your bulb didn't work."

Teacher: "But otherwise, we've had complete openness and trust."

Investigator: "O.K., let's sample another table. Let's go back to Sister _____."

Sister _____: "We didn't have any competition because we worked together to accomplish the end. We had complete openness with one another and we share all of our views."

Investigator: "Do you perceive any change in these variables? Let's say over the three sessions -- or do you feel that they've been about constant over the three sessions?"

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[1] Appendix H, p. 241.

Sister: "I think we're a little more together now than we had been."

Investigator: "Than you did at the beginning? O.K. Do you have any ideas why this might have happened? (Silence for five seconds). Any suggestions?"

Sister: "We've worked together before."

Investigator: "Right, you're from the same school. Right, Miss _____ is in the same school and I assume that you knew each other before the program. O.K., let's sample another table. Let's try Mrs. _____'s pair."

Teacher: "We said that there was no competition between the two of us at all."

Investigator: "O.K."

Teacher: "As far as trust goes, we were very good; and openness, we were willing to share and find out what the other one had to say."

Partner: "We didn't share any information, but we couldn't help seeing the light go on." (Twenty seconds discussion and laughter).

Investigator: "O.K. A little bit of competition there. Let's try Mrs. _____'s pair."

Teacher: "Yes, well we didn't feel the competitive spirit between us. It was a fairly complacent spirit compared to the rest of the group. We didn't cheat as much as they did." (Great uproar about "cheat").

Investigator: "That's interesting. The things we hear sometimes. O.K., yes?"

Teacher: "We trusted each other in judgment and since you had told us not to "cheat," we didn't bother to find out what the other pair of partners were doing, so...."

Investigator: "O.K., Mrs. _____, how about your pair?"

Teacher: "Well, um, we didn't find any competition between the two of us. I think we trust each other. At first we started manipulating objects, it sort of seemed that my partner sort of decided that she was going through magnets, and I was going through electricity."

Investigator: "You split your subject matter a little bit then, huh? O.K., let's have another group opinion."

Teacher: "There was no competition between us."

Investigator: "How about the rest of -- how about the table?"

Teacher: "No, because you've made it so pleasant that the competition I should think would be gone. We're all here to learn."

Investigator: "O.K. So you don't perceive competition with the other groups at all? More of a collaboration?"

Teacher: "We, I mean we didn't feel that we had to."

Investigator: "Right! That's what I mean. O.K., well, we've sampled all the tables now. Yes?"

Teacher: "I just wanted to say one thing. I think this working in pairs is just great. It gave me more of a sense of security because I feel that I lack it so much in science really and together; well, I felt she knew more than I did, but I felt that security, I really did. And I thought it was great."

Investigator: "I -- yes?"

Teacher: "I have a question. Will this competition be a problem between children? Do you want us to find that out for you, and how would we cope with it if we find it?"

Investigator: "Um, well actually I was just bringing up the question because I felt that it's something that we might consider -- that we might consider the competitive element in the classroom."[1]

Most of the remainder of session three dealt with procedures from questionnaire completion to observations of the teachers, with a brief consideration of teacher role and child pairing at the close of the session. See Appendix G on pages 166 through 204.

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[1] Appendix H, p. 243.

CHAPTER IV

FINDINGS OF THE STUDY

Introduction

This study is a case history of a training program for elementary science teachers. The study is product-oriented in the sense that the investigator is primarily interested in an effective product, that is, teachers who are teaching the innovation with high fidelity to the model presented. The study is theory-guided in the sense that selection conditions and training conditions were based upon the investigator's appreciation of some small group theory. The data are arranged with this theory in mind.

Two classes of data are reported. First are those data which were used to test the hypotheses. These include: (1) time measures; a) the thirty-minute per lesson criterion for implementation, b) total minutes observed taught by a project observer, and c) total minutes (unobserved) reported taught by the teachers, and d) average minutes taught per time taught; (2) attitude change, as indicated by responses on a semantic differential; and (3) lesson observations in the classroom, as reported by project staff.

The second class of data reported bears on the theoretical bases to a somewhat lesser extent than the first class. The investigator has been alert to judgmental data, the relevance of which may be only slowly emerging.[1] Included in this data class are (1) a description of the teacher population, (2) data (other than that in class 1) reported directly by staff on observation forms, and (3) follow-up data.

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[1] Robert E. Stake, "Objectives, Priorities, and Other Judgement Data," Review of Educational Research, 40(2): April, 1970, pp. 181-212.

Theory-Based Data

Sums of Minutes Observed Taught Over Four Observations

During an observer's visits to a project teacher's class, the observer noted the exact number of minutes during which an innovation-related lesson was being taught. This number of minutes is one of the major variables in this study, though for reasons to be mentioned later at least one other variable must be recognized as being at least as important as total time observed taught.

In Chapter I the investigator proposed the hypothesis that the factors "group" and "collaboration training" would facilitate implementation, and therefore the order of values for minutes observed taught from high to low would correspond to the treatment condition numbers in Table 2.

Table 2 on page 68 summarizes minutes observed taught for the four experimental groups. A significance level of .05 was set as the minimum indication of differences between the four groups. The four treatment groups differ significantly in relation to minutes taught while observed. Table 3 summarizes values obtained in a two-way analysis of variance for minutes observed taught.

Of more importance in terms of a performance-orientation to implementation is an analysis which shows the extent to which individuals in different treatment conditions achieved criterion.

Not only did the hypothesized order of implementation by treatment conditions fail to turn up, but the real order was found to have a basis nearly opposite that predicted by the investigator. The four

	1 DYADS: CONTENT AND COLLABORATION SKILLS			2 DYADS: ONLY CONTENT			3 ISOLATES: CONTENT AND COLLABORATION SKILLS			4 ISOLATES: ONLY CONTENT		
	OBSERVED	REPORTED	TOTAL	OBSERVED	REPORTED	TOTAL	OBSERVED	REPORTED	TOTAL	OBSERVED	REPORTED	TOTAL
	125	165	290	119	180	299	132	210	342	105	175	280
	95	120	215	132	195	327	78	260	338	155	225	380
	115	270	385	132	175	307	130	360	490	141	60	201
	92	300	392	158	70	228	90	90	180	133	125	258
	90	245	335	146	60	206	115	55	170	120	230	350
	95	90	185	116	80	196	90	90	180	167	80	247
	110	160	270	146	480	626	142	270	412	113	540	653
	105	240	345	123	205	328	105	80	185	190	270	460
	109	180	289	120	60	180	110	270	380	150	102.5	252.5
	108	300	408	100	70	170	148	210	358	112	180	292
Σ =	1044	2070	3114	1292	1575	2867	1140	1895	3035	1386	1987.5	3373.5
$\overline{X}$ =	104.4	207.0	311.4	129.2	157.5	286.7	114.0	189.5	303.5	138.6	198.75	337.35
σ =	10.68	70.54	75.18	16.32	121.99	134.25	22.51	98.85	115.67	25.93	131.21	134.27

TABLE 2. SUMS OF MINUTES TAUGHT OVER FOUR OBSERVATIONS, INCLUDING PROJECT OBSERVATIONS AND REPORTS BY TEACHERS OF UNOBSERVED TEACHING

Source of Variation	Sum of Squares	d.f.	Mean Square	F	P
A: Selection Condition	902.5	1	902.5	2.08	> .10
B: Training Condition	6,100.9	1	6,100.9	14.09	< .01
AxB: Selection x Training	0.1	1	0.1	-	-
Error: Within Treatments	15,592.5	36	433.13	-	-
TOTAL	22,596.0	39			
Between Treatments	7,003.4	3	2,334.5	5.39	< .01

	$\overline{X}$	σ
Dyads	116.8	18.54
Isolates	126.3	27.21
Content plus Collaboration Skills	109.2	18.25
Content Only	133.9	22.16

TABLE 3. TWO-WAY ANALYSIS OF VARIANCE FOR MINUTES OBSERVED TAUGHT

groups do not line up according to the proposed theoretical base, but rather break down into two pairs; the two isolate treatment conditions spent more time teaching while observed than did their dyad counterparts.

Criterion Level for Implementation

Criterion level for implementation was set at thirty minutes per lesson for each of four observed lessons. Table 4 on page 71 shows the extent to which this criterion was met by each of the teachers in the study. On four observations per teacher criterion performance would be 120 minutes. Negative numbers in Table 4 indicate the degree to which individuals failed to meet criterion. A zero indicates criterion and positive numbers show the extent to which an individual exceeded criterion.

Both treatment conditions receiving content only appeared to "try harder," that is, evidenced much higher levels of time investment above criterion than below criterion. Only 25% of the people receiving collaboration skill training met or exceeded criterion. Seventy percent of those receiving only content training met or exceeded criterion.

Minutes Reported Taught

Teachers were asked to report to the observer on each visit how much time they had taught in the week preceding the visit.

During training the teachers were told that the investigator expected that they would teach the innovation for a total of at least sixty minutes per week during the observation period. As the teachers were observed for four weeks, the time expectation criterion is then 240 minutes, which includes all teaching, whether observed or not observed.

	1 DYADS: CONTENT AND COLLABORATION SKILLS		2 DYADS: ONLY CONTENT		3 ISOLATES: CONTENT AND COLLABORATION SKILLS		4 ISOLATES: ONLY CONTENT	
	IMPLEMENTATION CRITERION	EXPECTATION CRITERION	IMPLEMENTATION CRITERION	EXPECTATION CRITERION	IMPLEMENTATION CRITERION	EXPECTATION CRITERION	IMPLEMENTATION CRITERION	EXPECTATION CRITERION
	+ 5	+ 50	- 1	+ 59	+ 12	+ 102	- 15	+ 40
	- 25	- 25	+ 12	+ 87	- 42	+ 98	+ 35	+ 140
	- 5	+ 145	+ 12	+ 67	+ 10	+ 250	+ 21	- 39
	- 28	+ 152	+ 38	- 12	- 30	- 60	+ 13	+ 18
	- 30	+ 95	+ 26	- 34	- 5	- 70	0	+ 110
	- 25	- 55	- 4	- 44	- 30	- 60	+ 47	+ 7
	- 10	+ 30	+ 26	+ 386	+ 22	+ 172	- 7	+ 413
	- 15	+ 105	+ 3	+ 88	- 15	- 55	+ 70	+ 220
	- 11	+ 49	0	- 60	- 10	+ 140	+ 30	+ 12.5
	- 12	+ 168	- 20	- 70	+ 28	+ 118	- 8	+ 52
n =	10	10	10	10	10	10	10	10
CRITERION LEVEL	120	240	120	240	120	240	120	240
CRITERION MET BY	1	8	7	5	4	6	7	9
$\overline{X}$ =	- 15.6	+ 71.4	+ 9.2	+ 46.7	- 6.0	+ 63.5	+ 11.2	+ 97.35
σ =	9.59	75.18	17.07	134.25	23.04	115.67	28.17	134.27

TABLE 4. CRITERION LEVELS FOR TIME TAUGHT, INCLUDING VARIATIONS OF INDIVIDUAL TEACHERS FROM IMPLEMENTATION CRITERION (30 MINUTES/LESSON FOR 4 LESSONS OBSERVED) AND EXPECTATION CRITERION (60 MINUTES/WEEK FOR 4 WEEKS, OBSERVED AND NOT OBSERVED)

Totals of time observed and time reported taught, though not observed, are reported in Table 2 on page 68. Variations from the implementation (observed) criterion and from the expectation (observed and not observed) criterion are reported in Table 4 on page 71.

A test of mean differences between the four treatment conditions yielded an F of 0.4, not significant at the .05 level.

No pattern emerges from an examination of the teacher-reported data in Table 2 on page 68. There is also no pattern to be found which might relate to either "content only -- collaboration skills" or "dyad-isolate" factors. There is great variation in reports within each treatment cell, and the differences reported appear to be randomly distributed.

Average Minutes Taught Per Time Taught

Table 5 on page 73 gives the average minutes taught during each lesson, according to teacher reports on the preliminary follow-up form (see page 105 for further follow-up data). Table 6 provides an analysis of variance for these values.

Treatment condition 1) (dyads, content and collaboration skills) and 2) (dyads, content only) averages are very close, as are treatments 3) (isolates, content and collaboration skills) and 4) (isolates, content only). The difference is about 50%, rather larger than we would expect by chance alone.

The teacher report data may indicate that teachers in both isolate selection conditions actually are teaching longer during each lesson, or that the teachers feel a need to report that they are teaching at this high level.

1. DYADS: CONTENT AND COLLABORATION SKILLS		2. DYADS: CONTENT ONLY		3. ISOLATES: CONTENT AND COLLABORATION SKILLS		4. ISOLATES: CONTENT ONLY	
TEACHER	AVG. MIN. TAUGHT	TEACHER	AVG. MIN. TAUGHT	TEACHER	AVG. MIN. TAUGHT	TEACHER	AVG. MIN. TAUGHT
21	20	01	25	27	30	07	-
22	15	02	15	29	20	09	30
23	30	03	-	28	-	08	-
24	30	04	15	32	25	20	15
25	20	05	20	30	45	10	20
26	-	06	20	39	-	11	30
35	20	15	30	31	45	12	45
36	30	16	-	34	50	19	45
37	15	17	-	33	20	13	35
38	15	18	-	40	30	14	45
Σ =	195		125		265		265
N=	9		6		8		8
$\overline{X}$=	21.7		20.5		33.1		33.1
σ =	6.61		5.84		11.9		11.6

TABLE 5. AVERAGE MINUTES TAUGHT PER TIME TAUGHT

Source of Variation		Sum of Squares	d.f.	Mean Square	F	P
A:	Selection Condition	1,076.46	1	1,076.46	15.72	< .01
B:	Training Condition	4.89	1	4.89	-	-
AxB:	Selection x Training	158.06	1	158.06	2.31	< .25
Error:	Within Treatments	2,464.58	36	68.46	-	-
	TOTAL	3,703.99*	39			
	Between Treatments	1,078.97	3	359.66	3.94	< .05

	$\overline{X}$	σ
Dyads	21.33	6.20
Isolates	33.13	12.97
Content plus Collaboration Skills	27.06	12.85
Content Only	27.86	10.59

TABLE 6. TWO-WAY ANALYSIS OF VARIANCE, AVERAGE MINUTES TAUGHT PER TIME TAUGHT (RATIO)

*Total variance reflects unequal subclass n's.

Whatever may be the case, these data are not consistent with the reports of observers in the classroom, or even reports by the teachers themselves during the implementation (observation) phase of this study. The data in Table 2 showed large differences between treatments with collaboration skills and those with content only. The data reported in Table 2 show large differences between dyads and isolates.

Attitude Change

Just how the individual teacher feels about elementary science in general, and how she feels about the curriculum innovation which she is asked to implement may be a reasonable indicator of what to expect in the way of implementation activity. In addition we might speculate that the training and subsequent teaching of the innovation could influence her feelings about science. The semantic differential is admirably suited to detecting influences of the training and trial of the innovation (see, for example, Kerlinger[1]).

The semantic differential instrument developed by the investigator was administered on three occasions to each teacher. First, before any training or description of the program had taken place; next, at the end of the last training session; and finally after the last of four observations.

Data from these three administrations were arranged so that a mean could be computed for each of the three scores for each administration for teachers in each of the four treatment conditions. *t* tests were performed, and scores obtained for differences between the first and second, second and third, and first and third administrations. Data from these comparisons are provided in Tables 7 through 10 on pages 77 through 80 and are displayed together in graphic format on page 81 as Figure 6.

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[1] Fred N. Kerlinger, Foundations of Behavioral Research (New York: Holt, Rinehart and Winston, Inc., 1966), p. 579.

A minimum probability of .05 was set for the determination of significant change in attitudes within treatment conditions. Dyads with collaboration skill practice (treatment condition 1) exceeded this level on all pre-post comparisons. Dyads with only content (treatment condition 2) exceeded this level on pre-post comparisons for the concept "How Teachers Feel about S.C.I.S.," but their pre-post ratings of the concept "How Teachers Feel about Elementary Science" were not significantly different. Isolates with collaboration skill practice (treatment condition 3) showed significant change only between pre- and post-ratings of "How Children Feel about S.C.I.S." There were no significant changes for the content only isolates (treatment condition 4). A comparison of how the different treatment conditions responded to the concepts, "How Teachers Feel about Elementary Science," "How Teachers Feel about S.C.I.S.," and "How Children Feel about S.C.I.S." is instructive.

Treatment Condition 1: Dyads, Content and Collaboration Skills -- Positive change of attitude toward all three concepts is indicated, with the smallest change turning up between the first and second administrations on concept 1, "How Teachers Feel about Elementary Science."

Worthy of note here are the starting and concluding values for each of the three concepts. Table 11 on page 82 summarizes these values for all four treatment conditions. Not unexpectedly, we find that growth is greatest in concept 3, "How Children Feel about S.C.I.S.," since children do not know the program before being taught it. The starting value for

CONCEPT	COMPARISONS BETWEEN ADMIN-ISTRATIONS	N1	N2	MEAN 1	MEAN 2	ST. DEV. 1	ST. DEV. 2	t	P
1. HOW TEACHERS FEEL ABOUT ELEMENTARY SCIENCE	1 and 2	10	10	4.452	4.605	0.439	0.304	0.904	.25
	2 and 3	10	10	4.605	5.018	0.304	0.187	3.661	.001
	1 and 3	10	10	4.452	5.018	0.439	0.187	3.752	.001
2. HOW TEACHERS FEEL ABOUT S.C.I.S.	1 and 2	10	10	4.413	5.027	0.448	0.296	3.610	.001
	2 and 3	10	10	5.027	5.241	0.296	0.333	1.516	.1
	1 and 3	10	10	4.413	5.241	0.448	0.333	4.685	.001
3. HOW CHILDREN FEEL ABOUT S.C.I.S.	1 and 2	10	10	4.119	4.771	0.408	0.410	3.564	.005
	2 and 3	10	10	4.771	5.238	0.410	0.445	2.435	.025
	1 and 3	10	10	4.119	5.238	0.408	0.445	5.859	.001

TABLE 7. t TEST DATA FOR THREE ADMINISTRATIONS OF SEMANTIC DIFFERENTIAL INSTRUMENT TO TEACHERS IN TREATMENT CONDITION 1 -- DYADS: CONTENT AND COLLABORATION SKILLS

CONCEPT	COMPARISONS BETWEEN ADMIN-ISTRATIONS	N1	N2	MEAN 1	MEAN 2	ST. DEV. 1	ST. DEV. 2	t	P
1. HOW TEACHERS FEEL ABOUT ELEMENTARY SCIENCE	1 and 2	10	10	4.652	4.838	0.705	0.595	0.637	.4
	2 and 3	10	10	4.838	4.668	0.595	0.979	-0.467	.8
	1 and 3	10	10	4.652	4.668	0.705	0.979	0.043	
2. HOW TEACHERS FEEL ABOUT S.C.I.S.	1 and 2	10	10	4.702	5.160	0.697	0.506	1.681	.1
	2 and 3	10	10	5.160	5.430	0.506	0.407	1.311	.25
	1 and 3	10	10	4.702	5.430	0.697	0.407	2.848	.01
3. HOW CHILDREN FEEL ABOUT S.C.I.S.	1 and 2	10	10	4.155	4.724	0.255	0.680	2.478	.025
	2 and 3	10	10	4.724	5.074	0.680	0.533	1.279	.25
	1 and 3	10	10	4.155	5.074	0.255	0.533	4.916	.001

TABLE 8. t TEST DATA FOR THREE ADMINISTRATIONS OF SEMANTIC DIFFERENTIAL INSTURMENT TO TEACHERS IN TREATMENT CONDITION 2 -- DYADS: CONTENT ONLY

CONCEPT	COMPARISONS BETWEEN ADMINISTRATIONS	N1	N2	MEAN 1	MEAN 2	ST. DEV. 1	ST. DEV. 2	t	P
1. HOW TEACHERS FEEL ABOUT ELEMENTARY SCIENCE	1 and 2	10	10	4.885	4.844	0.604	0.654	-0.147	
	2 and 3	10	10	4.844	4.766	0.654	0.698	-0.256	
	1 and 3	10	10	4.885	4.766	0.604	0.698	-0.408	0.8
2. HOW TEACHERS FEEL ABOUT S.C.I.S.	1 and 2	10	10	4.735	5.157	0.811	0.761	1.199	0.25
	2 and 3	10	10	5.157	5.116	0.761	0.928	-0.109	
	1 and 3	10	10	4.735	5.116	0.811	0.928	0.975	0.25
3. HOW CHILDREN FEEL ABOUT S.C.I.S.	1 and 2	10	10	4.710	4.771	0.727	0.678	0.194	
	2 and 3	10	10	4.771	5.271	0.678	0.618	1.722	0.1
	1 and 3	10	10	4.710	5.271	0.727	0.618	1.858	0.05

TABLE 9. t TEST DATA FOR THREE ADMINISTRATIONS OF SEMANTIC DIFFERENTIAL INSTRUMENT TO TEACHERS IN TREATMENT CONDITION 3 -- ISOLATES: CONTENT AND COLLABORATION SKILLS

CONCEPT	COMPARISONS BETWEEN ADMINISTRATION	N1	N2	MEAN 1	MEAN 2	ST. DEV. 1	ST. DEV. 2	t	P
1. HOW TEACHERS FEEL ABOUT ELEMENTARY SCIENCE	1 and 2	10	10	5.082	5.057	0.642	0.766	-0.079	
	2 and 3	10	10	5.057	4.924	0.766	0.746	-0.394	0.8
	1 and 3	10	10	5.082	4.924	0.642	0.746	-0.509	0.8
2. HOW TEACHERS FEEL ABOUT S.C.I.S.	1 and 2	10	10	5.196	5.407	0.677	0.482	0.802	0.25
	2 and 3	10	10	5.407	5.230	0.482	0.849	-0.575	0.8
	1 and 3	10	10	5.196	5.230	0.677	0.849	0.096	
3. HOW CHILDREN FEEL ABOUT S.C.I.S.	1 and 2	10	10	4.774	4.882	0.811	0.737	0.312	0.4
	2 and 3	10	10	4.882	5.108	0.737	0.671	0.713	0.25
	1 and 3	10	10	4.774	5.108	0.811	0.671	1.000	0.25

TABLE 10. t TEST DATA FOR THREE ADMINISTRATIONS OF SEMANTIC DIFFERENTIAL INSTRUMENT TO TEACHERS IN TREATMENT CONDITION 4 -- ISOLATES: CONTENT ONLY

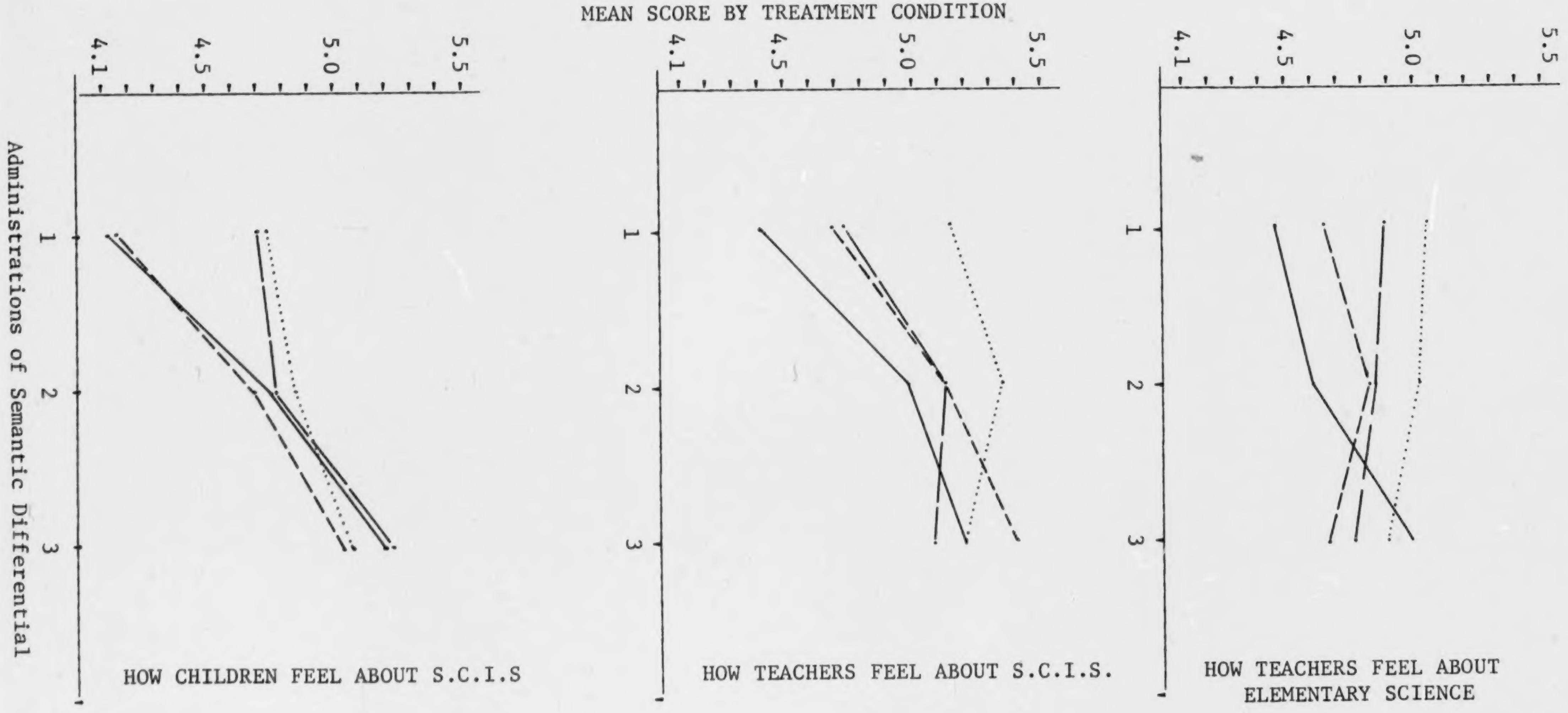

FIGURE 6. CHANGES IN MEAN SCORES ON THREE CONCEPTS OVER THREE ADMINISTRATIONS OF THE SEMANTIC DIFFERENTIAL

LEGEND:		
1.	DYADS: CONTENT AND COLLABORATION SKILLS	________________
2.	DYADS: CONTENT ONLY	— — — — — — —
3.	ISOLATES: CONTENT AND COLLABORATION SKILLS	_____ _____ _____
4.	ISOLATES: CONTENT ONLY	....

CONCEPT	TREATMENT CONDITION		FIRST	LAST	DIFFERENCE	P =
1. HOW TEACHERS FEEL ABOUT ELEMENTARY SCIENCE	1. DYADS:	CONTENT AND COLLABORATION SKILLS	4.45	5.01	.56	.001
	2. DYADS:	CONTENT ONLY	4.65	4.66	.01	
	3. ISOLATES:	CONTENT AND COLLABORATION SKILLS	4.88	4.76	- .12	.8
	4. ISOLATES:	CONTENT ONLY	5.08	4.92	- .16	.8
2. HOW TEACHERS FEEL ABOUT S.C.I.S.	1. DYADS:	CONTENT AND COLLABORATION SKILLS	4.41	5.24	.83	.001
	2. DYADS:	CONTENT ONLY	4.70	5.43	.73	.01
	3. ISOLATES:	CONTENT AND COLLABORATION SKILLS	4.73	5.11	.38	.25
	4. ISOLATES:	CONTENT ONLY	5.19	5.23	.04	
3. HOW CHILDREN FEEL ABOUT S.C.I.S.	1. DYADS:	CONTENT AND COLLABORATION SKILLS	4.11	5.23	1.12	.001
	2. DYADS:	CONTENT ONLY	4.15	5.07	.92	.001
	3. ISOLATES:	CONTENT AND COLLABORATION SKILLS	4.71	5.27	.56	.05
	4. ISOLATES:	CONTENT ONLY	4.77	5.10	.33	.25

TABLE 11. COMPARISON OF FIRST AND LAST MEAN SCORES ON SEMANTIC DIFFERENTIAL

"How Teachers Feel About S.C.I.S." is less than that of "How Teachers Feel About Elementary Science," as teachers are just meeting the program. The final value for "How Teachers Feel About S.C.I.S." is the highest final value, possibly indicating high gains for the innovation by this group. "How Teachers Feel About Elementary Science" also shows significant gains between the second and third, and the first and third administrations. This suggests that teaching the innovation, for this treatment cell at least, improves their attitude toward science in general.

Treatment Condition 2: Dyads, Only Content -- Here the general pattern of treatment 1 is repeated, but with smaller differences. For "How Teachers Feel About Elementary Science," this cell shows a gain between the first and second administrations, though this gain is wiped out by a drop on the third administration. "How Teachers Feel About S.C.I.S." and "How Children Feel About S.C.I.S." show gains between successive administrations. Though intermediate gains are relatively small, overall attitude change is positive and significant at the .01 and .001 levels, respectively.

Treatment Condition 3: Isolates, Content and Collaboration Skills -- The trend seen in treatment conditions 1 and 2 is continued here. For "How Teachers Feel About Elementary Science," there is a progressive worsening of attitude across the three administrations but generally the differences are not significant.

"How Teachers Feel About S.C.I.S." shows no significant change. "How Children Feel About S.C.I.S." shows a significant positive change between the first and third administrations, though this comes primarily during the implementation period.

Treatment Condition 4: Isolates, Only Content -- This condition contains negative features of both independent variables, and for that reason theoretically would have less support in facing the stress of change. The teachers' attitudes toward science and toward the project should reflect difficulties which they face.

The order of differences observed in the first three treatment conditions is also evident here. There is a progressive decline (with low alphas) in the teachers' attitudes toward science in general. "How Teachers Feel about S.C.I.S." shows improvement by the end of training, but a drop after teaching the unit. The net effect is a non-significant gain.

"How Children Feel about S.C.I.S." shows growth over the three administrations. This growth is small, though it approaches a significant level overall.

An examination of Figure 6 on page 81 will show how the value of the three concepts changed as teachers received training and then moved to the implementation stage and completed their four weeks of teaching with observation.

Observer Commentary -- A Taxonomy

Two categories on the implementation form were open-ended to a large degree. The investigator has outlined in Chapter 2 how he attempted to structure the responses of observers in these two categories. The observer wrote down as much as he could of the following types of information: (1) what the teachers does with materials, (2) instructions the teacher gives, (3) a sample of questions the teacher asked and some answers given by pupils, (4) use of materials by pupils, and (5) an interpretation of the quality of teaching.

The investigator's reason for collecting this highly variable judgmental data was to gain some sense of the fidelity of the implementation.

Most of the commentary was recorded as brief statements of four words of less. A complete listing of all comments made is provided in Appendix I on pages 247 through 249. Groupings of comments in Appendix I reflects the investigator's valuation of comments, especially as regards his placement of comments in positive and negative categories.

Observer comments were grouped in three major categories: (1) what the teacher does, (2) what the pupils do, and (3) the observer's own evaluations. Table 12 on page 86 contains frequencies of comment types, by observer and by treatment condition.

Findings in three categories of observer commentary were of special interest to the investigator:

Pupil Actions, Verbal, Positive -- Observers recorded samples of things children said. Samples of comments in this category include

Positive Comments

Pupils described objects
Pupils record observations
Pupils noisy

Negative Comments

Pupils quiet
Pupils do not attend to other pupils
No pupil-pupil interaction

Treatment conditions 1 and 3, both of which are skill training cells, show larger counts than the content only cells (2 and 4). Certain of these verbalizations were considered to be of a positive nature by the investigator. This last requirement, namely that the observer give samples of discourse, only partially protects against some kind of strongly biased descriptions by the observer.

TREATMENT GROUP	OBSERVER	TEACHER PER OBSERVER	TEACHER ACTION			PUPIL ACTIONS			OBSERVER EVALUATES (TEACHER)	
			INSTRUCTIONAL STRATEGIES		MATERIALS USE	VERBAL		MANIPU-LATIVE		
			POSITIVE	NEGATIVE		POSITIVE	NEGATIVE		POSITIVE	NEGATIVE
1. DYADS CONTENT AND COLLABORATION SKILLS	A	0								
	B	8	40	4	33	51	3	58	45	29
	C	2	13	4	4	11	1	12	16	2
2. DYADS: CONTENT ONLY	A	8	49	28	54	23	14	24	122	41
	B	0								
	C	2	13	5	3	6	1	10	4	5
3. ISOLATES: CONTENT AND COLLABORATION SKILLS	A	2	13	9	19	9	8	15	38	15
	B	1	4	1	5	7	1	8	6	3
	C	7	40	17	18	54	1	53	43	22
4. ISOLATES: CONTENT ONLY	A	4	35	2	36	14	5	20	85	26
	B	5	20	1	7	23	1	18	25	19
	C	1	2	1	4	4	0	3	7	2

TABLE 12. CLASSIFICATION OF OBSERVER COMMENTARY FOR THE FOUR TREATMENT CONDITIONS, CUMULATED OVER FOUR OBSERVATIONS (See Appendix I for comments comprising the above categories)

The content cells (2 and 4) have lesser counts for positive child verbalizations. The order of difference is 6 to 7 for process cells and 3 to 4 for content cells. These differences are consistent across observers by treatments, and may therefore be considered "real," that is, they may not be attributed to differences in rating between observers.

Pupil Actions, Manipulative -- Some samples of commentary under this category are

Pupils sorted objects
Pupils do not share materials
Restricted study of materials

Both process cells have much larger counts of comments referring to the child's use of materials than do the two content cells. Differences between observers appear not to determine the differences in totals observed. When comment frequency is related to the number of teachers observed in one cell by one observer, the frequency is found to be about 7 for both process cells and about 4 for the two content cells, from which it may be inferred that there was a much higher incidence of materials-use by pupils in the classes of process-trained teachers.

Observer Evaluates Teacher, Positive and Negative -- The investigator's value on this category of statements is shown by several samples of positive and negative instances.

Positive Comments

Nice teacher
Teacher encourages originality
Teacher experienced

Negative Comments

Teacher very poor
Teacher does not project interest
Lesson too long

Superficially the treatment condition totals indicate differences in ratio of positive to negative comments. The ratio of positive to negative comments for the two process cells is about 2 to 1, whereas for the two content cells, it is about 3 to 1. On closer examination we observe, however, that in the two content cells observer A accounts for most of the difference in ratio. The difference contributed by observer C in treatment 2 is zero. The differences contributed by observers B and C in treatment condition 4 are so small that they may be considered functionally zero. It is important to note that though the number of comments made by observer C in treatment condition 4 is small (since only one teacher was observed), the ratio of positive to negative comments agrees with the ratio of observer A in this cell.

The difficulty of getting trustworthy data under actual field conditions is great and is compounded by large variability in what observers are disposed to pay attention to. Even given that they have received some common training they will respond differently (unreliably) given the same situation (see the observer training description in Chapter 2). Nevertheless, in an hypothesis generating study, the great skill which humans have in detecting complex patterns makes them useful in settings like this where fidelity of transmission is of prime interest. Scheduling did not permit a complete randomization of observers between treatments and successive observations. The distinctive bias which one person can give to data is illustrated in Table 11.

Further Judgmental Data

Preparation Time

Preparation time required is the amount of extra time (beyond training) which the teacher reports she has to spend in order to teach the innovation with her class. If one teacher were learning from another, we might expect the preparation time for the pair to be less than for isolates, or teachers working alone. So we might expect dyads in general to show slightly less preparation time and dyads with process training to show even less time, i.e., this is the group most likely to share experiences. In fact, the differences were not significant but they were, nevertheless, in the direction predicted.

Reports, summarized in Table 13 on page 91 turn out to be in the direction predicted by the investigator. Treatment 1, Dyads: Content and Collaboration Skills, spends the least extra time; Treatment 4, Isolates: Only Content, and 3, Content and Collaboration Skills, are intermediate. Within the isolate and dyad selection conditions, those teachers who had process training spent less time in preparation than those who had content only training. Within content and process training conditions, those teachers who were in the dyads spent less time in preparation than those who were isolates.

An alpha of .05 was set by the investigator as the lowest significance level acceptable for differences between treatments. A test of mean differences between the four treatments yielded an F of .05, not significant. In comparing the combined treatments "all dyads versus all isolates," an F of 1.39 was obtained; this has an alpha of .25.

The difference between the combined treatments "all content versus all process" is not enough to warrant carrying out a test of significance.

Preparation Time Per Time Taught

Table 14 on page 92 reports the derived value, total preparation time reported divided by the total time observed taught.

Consideration of the amount of extra time a teacher must invest to be able to teach the innovation is most important in this study. The reader will recall that, in one training condition, time was devoted to collaboration skill training. This time was used at the expense of further content exposure. Underlying this strategy is the premise that gains from process training will at least equal, if not exceed, gains from extended content exposure -- when the area of replacement is not so large as to omit major concepts from training. In this study exposure to content was identical for both training conditions. Those teachers receiving process training, however, spent less time in contact with the materials and concepts during training, i.e., had less rehearsal.

An examination of Table 14 reveals negligible differences between three treatment conditions on this variable. The fourth cell has a somewhat larger ratio. Mean differences between the two content only and the two content plus collaboration skills cells yield an F value of 0.39. In order to be significant at the .05 level, the F value would have to be between 250 and 251. Therefore the null hypothesis that preparation time per time taught does not differ significantly between the two training conditions must be accepted.

TREATMENT CONDITION			
1. DYADS: CONTENT AND COLLABORATION SKILLS	2. DYADS: CONTENT ONLY	3. ISOLATES: CONTENT AND COLLABORATION SKILLS	4. ISOLATES: CONTENT ONLY
75	330	170	210
67	315	360	120
240	220	180	240
300	165	75	110
90	120	210	155
65	90	90	150
330	265	280	180
225	195	65	780
150	150	330	255
130	125	510	180
Σ = 1672	1975	2270	2380
$\overline{X}$ = 167.2	197.5	227.0	238.0
σ = 94.59	79.09	136.04	186.15
Differences between treatments were not significant.			

TABLE 13. TOTAL PREPARATION TIME REPORTED (MINUTES) FOR FOUR WEEKS

TREATMENT CONDITION			
1. DYADS: CONTENT AND COLLABORATION SKILLS	2. DYADS: CONTENT ONLY	3. ISOLATES: CONTENT AND COLLABORATION SKILLS	4. ISOLATES: CONTENT ONLY
.6	2.76	1.29	2.0
.71	2.4	4.61	.77
2.09	1.7	1.38	1.7
3.27	1.4	.835	.83
1.0	.82	1.83	1.3
.685	.78	1.0	.9
3.0	1.81	1.98	1.6
2.15	1.58	.62	4.1
1.38	1.25	3.0	1.7
1.20	1.25	3.45	1.6
Σ = 16.085	15.75	19.99	16.50
Differences between treatment conditions were not significant.			

TABLE 14. PREPARATION TIME/TIME TAUGHT (RATIO)

This finding is important because it indicates that, within certain limits, replacement of time which would normally be used in consideration of content by time during which the teacher receives collaboration training does not significantly increase the amount of time she must spend in preparation for the time she spends teaching the innovation.

Average Preparation Time Per Week -- Comparison Between Weekly Reports and Follow-Up Report

In Table 15 a comparison is made between the amount of time the teacher spent in preparation each week, as reported to the classroom observer, and the amount of time which she said she spent preparing on the average, in retrospect. If the teacher in retrospect reported more preparation time than she reported to the observer, this was taken by the investigator as an indication that the teacher found implementation difficult. A smaller retrospective estimate would indicate less difficulty in implementation.

The derived value here is reached by dividing the first into the last reported value. This yields a ratio which (a) if 1.0 means the weekly reports and the retrospective report agreed, (b) if less than 1.0 indicates that after the program preparation time is thought of as being relatively light, and (c) if more than one indicates that after the program preparation time is viewed as having been relatively high.

Favorable evaluations of preparation time are in the majority with a smaller number being unfavorable. A few of the latter run ratios over 1.0 in both of the process cells. Content only cells are very close for mean values, and considerably less than 1.0. Means for

1. DYADS: CONTENT AND COLLABORATION SKILLS				2. DYADS: CONTENT ONLY				3. ISOLATES: CONTENT AND COLLABORATION SKILLS				4. ISOLATES: CONTENT ONLY			
TEACHER	FIRST	FINAL	RATIO	TEACHER	FIRST	FINAL	RATIO	TEACHER	FIRST	FINAL	RATIO	TEACHER	FIRST	FINAL	RATIO
21	19	20	1.05	01	83	60	.72	27	43	60	1.39	07	-	-	-
22	17	15	.88	02	79	60	.76	29	90	60	.67	09	30	25	.83
23	60	30	.50	03	-	-	-	28	-	-	-	08	-	-	-
24	75	60	.80	04	41	15	.37	32	19	15	.79	20	28	60	2.15
25	23	120	5.20	05	30	30	1.00	30	53	60	1.13	10	39	20	.51
26	-	-	-	06	23	30	1.30	39	-	-	-	11	38	20	.53
35	-	-	-	15	66	60	.91	31	70	50	.72	12	45	50	1.11
36	-	-	-	16	49	60	1.22	34	16	30	1.88	19	195	150	.77
37	38	30	.79	17	-	-	-	33	83	60	.72	13	64	30	.47
38	33	20	.61	18	-	-	-	40	128	105	.82	14	45	30	.67
Σ =	265	295	9.83		371	315	6.28		502	440	8.12		484	385	7.04
$\overline{X}$ =	37.9	42.1	1.40		53	45	.897		62.75	55	1.015		60.5	48.13	
σ =	22.0	37.4			23.57	19.36			37.89	26.32			55.47	43.58	

TABLE 15. AVERAGE PREPARATION TIME PER WEEK -- COMPARISON BETWEEN WEEKLY REPORTS AND FOLLOW-UP REPORT

CODE: 1.0 = RETROSPECTIVE AND WEEKLY REPORTS AGREED
< 1.0 = PREPARATION TIME IS VIEWED AS BEING RELATIVELY LIGHT.
> 1.0 = PREPARATION TIME IS VIEWED AS BEING RELATIVELY GREAT.

the four cells may actually be misleading, since the majority of changes show a favorable ratio.

Collaboration Skill Training

To distinguish what the recruitment versus process training effects are, an instrument, "Growth of a Pair," was administered prior to training and at conclusion of training. If the recruitment variable is salient, then there should be more growth for the dyads with collaboration training than for the isolates with collaboration training. Scores are provided in Table 16 on page 96.

Shifts in these means, when observed, turned out to be quite small. There were changes in 14 of the 20 comparisons. Because the changes were so small, a "sign test" of mean differences was carried out to determine whether or not the shifts were significant.

For the isolates there were seven negative changes and three scores did not change. This yields a Z - 2.25, which converts to F(z) = .98, which indicates significance at the .02 level. This suggests that there is possibly a small recruitment effect. While the sign test is not sensitive to the direction of shift, it is necessary to go one step further and look at the data. Interestingly enough, one finds that among the isolates all changes were negative, while among the dyads 5 of 7 changes were positive. And so there may be some recruitment effect, but it is probably rather subtle.

For the dyads there were two negative changes, five positive changes, and three scores did not change. The shift was not significant.

SELECTION	TEACHER CODE #	SCORE 1	SCORE 2	CHANGE	SIGN	Z
ISOLATES	34	4.33	4.33	0	0	Z = 2.25 F(z) = .9877755
	31	4.00	4.00	0	0	
	27	4.11	4.00	.11	-	
	29	4.11	3.78	.33	-	
	32	4.11	4.11	0	0	
	28	4.33	4.22	.11	-	
	39	3.78	3.67	.11	-	
	30	3.78	3.67	.11	-	
	33	4.56	4.44	.12	-	
	40	4.67	4.44	.23	-	
DYADS	21	4.33	4.33	0	0	Z = .78 F(z) = .7823046
	22	4.00	4.11	.11	+	
	36	4.00	4.77	.77	+	
	35	4.11	4.66	.55	+	
	26	3.77	3.88	.11	+	
	25	3.66	3.33	.33	-	
	24	4.11	4.22	.11	+	
	23	4.13	3.78	.35	-	
	38	4.44	4.44	0	0	
	37	4.56	4.56	0	0	

Sign test comparing shifts in teacher's perceptions of collaboration in their training dyad were not significant.

TABLE 16. COMPARISONS OF SCORES ON THE "GROWTH OF A PAIR" INSTRUMENT

Preliminary Follow-Up Data

Procedures in applying this instrument were outlined in Chapter 2. Twenty, or half, of the teachers attended voluntary follow-up sessions. Each completed a follow-up form. Forms were mailed to the other twenty teachers, with a response of twelve. This was a response of 80% on what turned out to be a voluntary post-hoc measure.

Lessons Completed -- Table 17 on page 98 give teacher reports of lessons completed. Twelve lessons were outlined for the teachers. Quite a lot of selection went on, with only four teachers completing all twelve. Predictably enough, those lessons most frequently deleted were "messy," such as lessons 7 and 9, or were complex in terms of management and testing for learnings on the part of the children (lessons 11 and 12).

A breakdown by treatment condition is provided. Little information is gained by it, however. Lessons 1 - 5 and 10 are implemented by a higher number of teachers in each condition. In lessons 6 -9 and 11 - 12, there is a lower implementation along with great variation between treatments on specific lessons.

Lesson 10, Floating and Non-Floating Objects, deals with a topic which may be relatively familiar to elementary teachers. This kind of lesson is often covered in kindergarten or first grade. If lesson 10 is disregarded, high drop-out for treatment 2 (dyads, content only) is seen to begin with lesson 6. The other treatments are close behind, however, with high drop-out commencing at lesson 7.

A look at total lessons taught by each treatment condition indicates (1) a very small advantage of dyad over isolate, and (2) a slightly

TREATMENT CONDITION	SEQUENCE AND CONTENT OF LESSONS											
	1	2	3	4	5	6	7	8	9	10	11	12
	OBJECTS IN THE CLASSROOM	OBJECT COLLECTIONS	AN OBJECT HUNT	OBSERVING PLANTS	GRANDMA'S BUTTON BAG	OBSERVING LIQUIDS	ROCK CANDY AND LUMP SUGAR	EXPERIMENTING WITH LIQUIDS AND MIXTURES	SOLID AND LIQUID WATER	FLOATING AND NON-FLOATING OBJECTS	EXPERIMENTING WITH AIR	EXPERIMENTING WITH AIR AND WATER
1	9	8	8	7	9	9	4	7	4	6	7	4
2	7	7	7	7	7	4	2	3	5	7	2	2
3	8	8	7	7	8	7	4	4	2	7	2	1
4	8	8	7	6	8	8	6	7	4	7	1	1
Total	32	31	29	27	32	28	16	21	15	27	12	8

Treatment 1:	Dyads, Content and Collaboration Skills	82
Treatment 2:	Dyads, Content Only	60
Treatment 3:	Isolates, Content and Collaboration Skills	65
Treatment 4:	Isolates, Content Only	71

TABLE 17. LESSONS COMPLETED

greater, though still very small, advantage of collaboration training over content only. These differences between treatments may be artifact, however, as response was not complete on the follow-up form. Had all teachers responded, the balance could have shifted to wipe out these small differences between selection conditions and between training conditions.

What Has Been the Response of Other Teachers in Your School? -- Table 18 on page 100 compares the frequency of response on this item for the four treatment conditions. Of those teachers responding on this item (29), there was a nearly even split between positive and negative comments (15 positive, 14 negative).

Significant difference in response between treatment conditions can not be claimed.

What Changes Would You Suggest in the Lessons? -- Response on this item was rather slim. Five left it blank, eleven said changes should be made, and sixteen said none or that they think the unit is fine just as is. Of those suggesting changes, most dealt with materials problem rather than the structure of the lessons (5 out of 12). The changes would be in favor of more materials or dropping certain materials. There was a minority of comment saying that the materials were inappropriate, or too messy for this particular teacher's class (2 out of 12). One comment was a plea for smaller class registers. Five comments were made relating to the lessons: "add more lessons," "our class made a notebook of observations," "make the lessons simpler -- they are too difficult for my class," "the teacher does not get

TREATMENT CONDITION	NO RESPONSE	HIGH INTEREST	INTEREST	NO INTEREST	HOSTILE
1. DYADS: CONTENT AND COLLABORATION SKILLS	1	3	4	2	
2. DYADS: CONTENT ONLY	3	2	1	4	
3. ISOLATES: CONTENT AND COLLABORATION SKILLS	3	1	2	3	1
4. ISOLATES: CONTENT ONLY	4		2	4	
TOTALS	11	6	9	13	1

TABLE 18. WHAT HAS BEEN THE RESPONSE OF OTHER TEACHERS IN YOUR SCHOOL?

enough background for handling liquids." Eight teachers left the space blank, and twelve said "none" -- giving twenty or thirty-two who made no suggestions or changes.

My Willingness to Use the Unit Again Next Year -- Response here was strongly in favor of continuing use of the innovation. The responses are presented in Table 19 on page 102. One teacher stated that she would not be teaching first-grade next year, but did not say whether or not she would carry the ideas of the program to her new assignment. One teacher responded that she would continue if given support within the school, but held out little hope for that support. She felt that the pressure for quiet, immobile classes which adhere strictly to the prescribed course of study is insuperable in her school.

It is of some interest to determine whether statements of this sort are good predictors of what teachers will actually do when left to themselves. And so the investigator, in the following year, canvased teachers in the middle of October to determine whether any science was actually being taught. This data are to be found in Table 21 on page 105. In general, out of a possible 35 teachers who are in the same position in the following year, twenty-three are now teaching or expect to start teaching shortly.

Response of My Class to the Unit -- All respondents indicated the highest level of pupil interest in the materials presented. This agrees well with the teacher's acceptance of the materials, indicated in the above section. Five teachers expressed reservations about using the materials again, while indicating this very high level of pupil interest.

TREATMENT CONDITION	NO RESPONSE	IF CONSULTANT HELP IS GIVEN	IF SUPPORTED IN MY SCHOOL	DEFINITELY, EVEN IF ALONE
1. DYADS: CONTENT AND COLLABORATION SKILLS	2	2		6
2. DYADS: CONTENT ONLY	3			7
3. ISOLATES: CONTENT AND COLLABORATION SKILLS	2	1		7
4. ISOLATES: CONTENT ONLY	2		2	6
TOTALS	9	3	2	26

TABLE 19. MY WILLINGNESS TO TEACH THE UNIT AGAIN NEXT YEAR.

How Comfortable Do You Feel with the Content? -- Teachers were asked to give a rating between 1 (uncomfortable) and 10 (very comfortable). One rating of 4 was given, but the next lowest was 7. The 4 rating was given by a teacher in the Isolate: Content Only condition, though I would hesitate to make a strong claim about the significance of this. This teacher was a special science teacher in her school, and her total teaching time was among the top two values given out of all forty teachers. Table 20 on page 104 provides the frequencies of responses made within each of the four treatment cells.

Final Follow-Up

A check on the status of the innovation with project teachers was carried out early in the year following the field study. Each teacher was contacted in the latter part of October to determine whether or not she was still implementing the innovation. On page 105 the findings of this follow-up are presented in Table 21.

Teachers were asked if they were now teaching. If the answer was "yes," the investigator asked which lessons had already been taught. If the teacher was not then teaching, she was asked if she planned to teach at all, and if so, when.

Most of the teachers saying that they intended to teach indicated that they would be ready to begin within about two weeks. This delay was in most cases attributed to a need to establish classroom routines early in the year, before beginning to allow children more freedom of initiative.

The investigator assumed this "promise to teach" to be valid if the teacher seemed enthusiastic about using the innovation. In some

<table>
<tr><th rowspan="2">TREATMENT CONDITION</th><th rowspan="2">NO RESPONSE</th><th colspan="4">UNCOMFORTABLE</th><th colspan="4">INDIFFERENT</th><th colspan="3">VERY COMFORTABLE</th></tr>
<tr><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th></tr>
<tr><td>1. DYADS: CONTENT AND COLLABORATION SKILLS</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>2</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>2. DYADS: CONTENT ONLY</td><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>2</td><td>3</td><td></td><td>2</td></tr>
<tr><td>3. ISOLATES: CONTENT AND COLLABORATION SKILLS</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>3</td><td></td><td>5</td></tr>
<tr><td>4. ISOLATES: CONTENT ONLY</td><td>2</td><td></td><td></td><td></td><td></td><td>1</td><td></td><td></td><td>1</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>TOTALS</td><td>8</td><td colspan="7">1</td><td colspan="4">31</td></tr>
</table>

TABLE 20. HOW COMFORTABLE DO YOU FEEL WITH THE CONTENT OF THE UNIT?

TREATMENT CONDITION	TEACHING INNOVATION	NOT TEACHING INNOVATION
1. DYADS: CONTENT AND COLLABORATION SKILLS	2 now teaching 4 soon to begin TOTAL = 6	2 no longer in position 2 appear to reject innovation TOTAL = 4
2. DYADS: CONTENT ONLY	1 now teaching 5 will begin soon TOTAL = 6	3 no longer in position TOTAL = 3
3. ISOLATES: CONTENT AND COLLABORATION SKILLS	2 now teaching 4 will begin soon TOTAL = 6	3 appear to reject innovation TOTAL = 3
4. ISOLATES: CONTENT ONLY	2 now teaching 3 will begin soon TOTAL = 5	3 appear to reject innovation TOTAL = 3
	Total dyads teaching = 12 Total isolates teaching = 11 Total skills teaching = 12 Total content teaching = 11	Total dyads rejecting = 2 Total isolates rejecting = 6 Total skills rejecting = 5 Total content rejecting = 3
	TOTAL TEACHING = 23	TOTAL REJECTING = 8

TABLE 21. STATUS OF INNOVATION AT FINAL FOLLOW-UP.

few cases, teachers indicated that they would use the innovation much later, or that they might use the innovation. These cases were classified arbitrarily as rejectors.

Nearly all of the teachers felt that the innovation involved important learning experiences for their children. Three teachers said that their children were too young to profit from such complex activities -- it was only "play" for them, and very disturbing to all concerned. In light of the investigator's experience with four- and five-year olds, this appears to be a rather perfunctory rationalization.

Among those teaching now, there was some open expression of hesitancy concerning objects such as marbles, thumb tacks, balloons, beans, and the liquids. Teachers frequently view these objects as distractions or dangers to children, even though their use may involve learning.

Two teachers have retreated to workbooks. They suggest that they may use the innovation, where it complements the workbook activities.

CHAPTER V

DISCUSSION

The Study

It is generally agreed that if the new elementary school science programs are to be implemented, teachers must receive some sort of training in the programs. This training requirement is based in part on the teacher's need for science information, or content. Perhaps even more important for the teacher are new role expectations where children operate primarily as investigators in a laboratory situation and the teacher is their consultant and guide in inquiry.

Traditionally, training programs have been conceived as including content and method. It has been assumed that if the teacher knows what to teach and how to teach it, then he or she will teach the program. Since many teachers trained according to this plan do not teach the programs, it may be that the "content plus method" approach is not enough. There are social aspects to implementation, and perhaps they should be considered in the design of teacher-training program in elementary school science.

This study was undertaken in order to clarify the effect which two major design decisions may have on the production of an effective implementation of an elementary science innovation following a brief training program.

The first design decision was to select trainees in pairs from their schools. Small group theory underlying this decision indicates that when an implementation partner is present the stresses which normally impinge on the innovator in the back-home situation may be reduced or ameliorated through interaction with another person who is facing similar stresses. That is, they tend to support one another. Half of the trainees were selected as isolates and acted as controls for the pairs, or dyads.

The second decision was to train not only for the science content of the innovation, but also to provide activities which were intended to enhance collaboration processes within the trainee pairs. These activities were intended to promote collaboration in the dyad, or training pair, and were designed in such a way that they were context-relevant. That is, they involved tasks dealing with the science content of the innovation employed. As a control on collaboration skill training, half of the trainees received science content training only. Total training time for each of the groups was six hours.

By setting up two parallel training sessions, one with content from science only and one with science content plus collaboration skills, it was possible to effect a two-by-two experimental design. Half of the trainees in each session were isolates and half were pair partners chosen from the same school (dyads).

All trainees experienced three two-hour training sessions, received a teacher's guide and a kit of materials, and began to teach the innovation (implementation). All were observed once a week for a total of four weeks. Three trained observers went into their classrooms, made notes on what occurred in terms of sample comments by both teacher and children, materials used, and gave their own evaluation of the lessons. The observers were not aware of the specific intent of the study, and were not told to which treatment condition any teacher belonged. These reports were passed on to the investigator.

Several instruments were employed in order to gain information on the characteristics of the trainees, growth in collaboration skills for those trained in collaboration skills, changes in trainee attitude relating to elementary science in general and the innovation specifically, and the status of the innovation with teachers at the end of the implementation period.

A study of this sort is certainly "messy" if it is conceived of as proceeding from theory with the expectation that some clear-cut and easily quantifiable outcomes will be produced which may then be related back to theoretical and operational hypotheses. The investigator has embraced an engineering design model in this study because he is primarily interested in an effective product. The product is an in-service teacher training program which is effective in that it employs strategies aimed at long-term implementation. In-service courses are often little more than "good experiences" for teachers, and are hardly worth the time and trouble taken -- not to mention expense -- if considered in the light of long-range changes in the teaching behaviors of trainees.[1]

What can a training program such as the one presently under consideration tell us as practitioners who are interested in effecting long-term behavioral change? Certainly the data generated by this study do not produce a clear, unified proposal for the conduct of such programs in the future.

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[1] See, for example, the survey of literature on this point made by Rowe for the National Science Foundation (mimeo, Professor Mary Budd Rowe, Teachers College, Columbia University, New York, New York 10027).

Limitations of the Study

Observer Training

Perhaps the most critical difficulty in the conduct and appraisal of this program has been the training of observers. As the investigator has more fully outlined in Chapter 2, the three observers were brought together and along with the investigator evaluated a videotaped science lesson using the observation form reproduced in Appendix A. At this early stage in the study, before teacher training had begun, the investigator was primarily concerned with numerical data which could be collected with high reliability (inter-observer) and then related to experimental treatments to show which of the four experimental cells had the highest output in terms of implemented procedures. In other words, who taught the most, and what selection condition and training condition produced this high rate of implementation. While a reasonably satisfactory agreement between observers was achieved in the training session, it became obvious once the experiment began that observer biases were creating problems. The observers came together for another session. While observers can make valuable contributions, the context in which they make judgments needs more examination.

While judgmental data generated by the observer may be difficult to interpret, it is nevertheless possible that this data may turn out to be of high value in interpreting the quality of an implementation. That is, it is through this judgment data that the investigator will get his closest approximation of the fidelity with which the innovation is taught.

Time taught and materials in use mean very little when children are not encouraged to investigate the materials, to share what they have found out in their inquiry, to interpret their findings, and to use what they have learned in new situations. In evaluating an implementation we must learn more about the collection and utilization of judgment data. Such data is often avoided by researchers because it is not readily fitted into categories for statistical analysis.

Training Program

The teacher training program was designed to transmit certain skills in working with children in elementary science lessons, with a strong emphasis on guided inquiry by the children. Since mutual support and collaboration might facilitate implementation, in one of the two parallel training programs the teachers were also exposed to activities designated as practice in collaboration skills. Total training time for each of the two groups was fixed at six hours.

Implementation figures (see Tables 1 and 3) indicate that (1) regardless of treatment all teachers trained taught the innovation, (2) selection condition: the expectation criterion of 60 minutes total teaching time per week was met by 13 of 20 teachers in the dyad selection condition and by 15 of 20 teachers in the isolate selection condition, and (3) training condition: the expectation of 60 minutes to be taught per week was met by 14 or 20 teachers in the content plus collaboration skills training condition and also by 14 of 20 teachers in the content-only training condition. Analysis of variance suggests that the selection condition is a better predictor of implementation (see Table 3). The fact that implementation occurred generally in both groups washes out to some extent the contributions to implementation made by the distinction between selection condition and training condition. Though implementation is high for all conditions, selection appears to be the more salient factor in this study.

Though collaboration skills seem to have some effect on implementation of the innovation, in general the investigator must conclude that training for these skills did not achieve the results hoped for. The investigator is not a group process trainer, and a careful reading of the tapescripts of the training sessions in Appendices G and H provides only small evidence for a contention that there was in fact a significant difference in the training provided to the two parallel groups. This must be regarded as a factor requiring more attention in a future study.

Guidance in planning the activities employed as collaboration skills practice was afforded the investigator by a group process consultant. This consultant did none of the training and did not visit the sessions or evaluate the audio-tapes. In fact, he only provided advice on planning the sessions to the investigator, who found that he was unable to follow this advice at all times. It should also be noted that this individual seemed to focus on inter-personal rather than task-facilitation training.

In short, evidence that the two training programs were in fact as different as they were intended to be is equivocal. In the future a group process person should work closely with the science specialist, either doing the collaboration skills segment himself, or providing expert guidance for the science person. Only in this way can we get a definitive indication of the effect of collaboration training.

In Chapter II it was mentioned that only one isolate was chosen from any given school in order to minimize the likelihood of contact (outside of training) between the isolate and any other trainee. At the same time, however, one theoretical point offered in Chapter I is that the isolate will seek the support of another person as a buffer against the "stress of innovation."

Participants 33 and 40, both in the isolate selection condition and content plus collaboration skills training condition, established telephone contact and discussed their experiences with the innovation after completion of the training program. The interaction may be considered both a limitation and positive outcome of the study. Data generated by the two participants, who worked together during training, are in a sense contaminated. Procedures of assignment were designed so that insofar as possible trained isolates would not interact outside of the training sessions.

Since these two isolates chose to interact, it is at the very least interesting to note that they were trained in collaboration skills. This is hardly the basis for any statement regarding cause-effect, however, and is simply accepted as a positive instance in support of one of the theoretical tenets of the study.

Experimental Schools

Carrying out an experimental program in an established social system, when the investigator is an outsider, and where an ongoing program carried out by persons in well-defined roles already exists, provides a high challenge to the resourcefulness and social skills of the investigator and requires considerable tolerance on the part of the host system.

This study was carried out in such an established system, one school district of a tightly organized city school system. All public primary schools in the district were involved, and in addition eight private religious-based schools participated. The study was viewed by school officials as not only a venture in teacher training with an innovative curriculum, but also as an experiment in public-private school collaboration, an emergent aspect of community relations in the urban complex. It is of some interest to note that the private schools sought further collaboration with the district in the fall following this experiment.

An atmosphere of trust is essential in order to gain full participation by all persons concerned. In this experiment one person was crucial in creating an aura of credibility, and actually gaining acceptance of the experiment by district administrators. The district science supervisor first promoted acceptance of the experiment, then acted as a translator putting the language of the investigator into the language of the school system, later acted to promote trust between the investigator and school administrators, and then served as a primary "firefighter" in sensing problems and reporting them to the investigator before they could get out of control. These are a lot of words to say one basic thing -- that an effective liaison person inside the system may well be essential for the success of an experimental program, especially when the system does not perceive the experiment as being necessary for its welfare.

In a study of this complexity the investigator hopes through careful advance planning to minimize sources of variance which are not under his control. This investigator has met several situations during the course of this study which must be noted in order to have an accurate vantage point from which to view the outcomes.

When negotiations were begun with the local school district, there was an understanding that the investigator would have access to all available first-grade teachers in all of the schools. This was necessary so that truly random assignment could be made, first to dyad or isolate condition, then of the teacher or teachers participating in any given school. When lists became available, it was found that in thirteen of thirty schools only one teacher was available for selection. Two of these schools were further limited in that the teacher from one could attend on Tuesday only, and the teacher from the other could attend on Wednesday only.

Reasons given for having only one teacher available included (a) only one first grade in the school, (b) other teachers are too deeply involved in after-school study programs, in-service courses, or other experimental programs, and (c) other teachers refuse to cooperate for personal reasons. Where teachers were available on a specific day only, the reason was participation in in-service or after-school courses on the other day.

Seventeen schools were available for assignment to isolate or dyad condition. Two of these schools were available for Tuesdays (content only session) only. Four of the seventeen, though available for either condition, had to be assigned to the dyad condition as they were the only remaining private schools.

Effectively then, thirteen of thirty units were available for random assignment on the dichotomous independent variable "dyad-isolate."

Twenty-six of thirty units were available for random assignment to the other dichotomous independent variable, "content training-content and process training."

It should be kept in mind that this school district is quite large in both number of schools included and the amount of territory included (considering that it is within an urban sprawl). It is unlikely, therefore, that the restraints placed on the investigator in this district regarding random assignments to experimental condition are in reality considerably less than they might have been in another location.

Some Major Outcomes

With all of the foregoing difficulties in mind, what can one reasonably deduce from the data?

First, all teachers trained in this study actually implemented the innovation at some level during the period when they were observed. This point becomes rather more significant than those to follow when we consider that the teachers all volunteered for training, that implementation was not mandated by any of the participating schools, and that though an expectation of implementation was always present the teachers at all times had the option to reject the innovation and refuse to teach innovation-related or other science lessons for project observers (without penalty).

Second, equipment provided was used by all of the teachers, and was observed in use in 159 of 160 lessons. In the one lesson where kit materials (or materials suggested by the manual to be provided by the teacher) were not observed in use, the teacher told her observer that she had completed all twelve innovation lessons, and was now extending concepts previously taught. This occurred on the fourth observation. The lesson was an extension of concepts involved in the innovation, and included interactions between alnico magnets, pieces of glass, water, plastic objects, tacks, and bobby pins.

Third, of the twelve lessons suggested in the teacher's manual, all were tried by at least one teacher in each treatment condition according to teacher report on the follow-up instrument. During the implementation period (observed teaching) dyads with content-only training taught all twelve lessons. Dyads with content plus collaboration skills were observed teaching ten of the twelve lessons, and both isolate treatment conditions were actually observed teaching nine of the twelve lessons suggested.

Fourth, sums of minutes observed taught over four observations were found to vary significantly (at the .01 level) between the four experimental treatment conditions, with content-only trainees implementing at a higher rate than content plus collaboration skills trainees. Within pooled dyads and isolates, those receiving content-only training implemented at a higher rate. The most productive condition was dyads receiving content-only training. Teaching time reported taught (but not observed) was found not to vary significantly between the four treatment conditions.

Fifth, a large number of teachers in each treatment condition met either the implementation criterion or the expectation criterion. Both criteria are indicators of teaching. The implementation criterion deals with time taught and actually observed. The expectation criterion includes time observed taught and time reported (by each teacher, each week during the implementation period) taught. This indicator assumes relatively great importance due to the high congruence between teacher self-reports and project staff observations.

The implementation criterion of 30 minutes observed taught per week was met or exceeded by (1) one of ten teachers in treatment condition 1, dyads, content plus collaboration skills training; (2) seven of ten teachers in treatment condition 2, dyads, content only training; (3) four of ten teachers in treatment condition 3, isolates, content plus collaboration skills training; and (4) seven of ten teachers in treatment condition 4, isolates, content only training.

The expectation criterion of 60 minutes taught, observed and not observed, was met or exceeded by (1) eight of ten teachers in treatment condition 1, (2) five of ten teachers in treatment condition 2, (3) six of ten teachers in treatment condition 3, and (4) nine of ten teachers in treatment condition 4.

Sixth, Figure 6 on page 37 shows that in terms of the meanings of the three concepts presented on the semantic differential instrument (How Teachers Feel about Elementary Science, How Teachers Feel about S.C.I.S., and How Children Feel about S.C.I.S.) there was more variability of response (a greater spread) prior to training than was found at the end of training. After teaching the innovation there was even closer agreement (less spread) overall.

The attitudes of isolates regarding the innovation (How Teachers Feel about S.C.I.S.) appeared to improve after training, but dropped off after teaching the innovation. On the other hand attitudes of dyads toward the innovation changed in a positive direction as a result of training and became even more positive after teaching the innovation.

Attitudes of isolates toward elementary science in general (How Teachers Feel about Elementary Science) became less positive after training, and dropped off even more after teaching the innovation. At the same time content-only dyads had an improved perception of elementary science after training, which later dropped off after teaching the innovation. Dayds with content plus collaboration skills gained more positive attitudes over all administrations on all three concepts.

Seventh, perhaps a very telling indication of the effectiveness of the training program is offered by responses to two questions on the first follow-up instrument. In answer to the question "How Comfortable Do You Feel with the Content of the Unit?" (see Table 20), on a scale of 0 - 10 (0 = uncomfortable, 5 = indifferent, 10 = very comfortable), 31 of 32 respondents ranked themselves seven or above. This may be a strong indication that the training program was successful in terms of transmitting the content of the innovation, even though content transmission assumed a role secondary to teaching methodology in the training sessions.

In response to the item "My Willingness to Teach the Unit Again Next Year," 26 of 31 respondents indicated that they were willing to teach again even if they had to do it strictly on their own. The other five indicated that they would need some level of support, either within their own school or from an outside consultant. This indicates that the teachers responding positively felt they had a certain ability to cope with the problems of continuing the implementation even though they might have no further support for their efforts.

It is most important here that these 26 of 31 teachers are willing to use the innovation again, whatever the reasons may be. The investigator would like to believe that this willingness is in some large part due to his training program, but whatever the source a "willingness" of over 80% is satisfactory.

Eighth, and finally, the status of the innovation at the final follow-up is of interest because it indicates how good or bad a predictor the "willingness" responses were; that is, we can ask what the teachers actually did with the innovation during the following school year.

Five teachers were no longer in their positions. Twenty-three teachers were either presently teaching the innovation or intended to begin within a few weeks. This "intention" leaves room for doubt, as the study was terminated shortly after the follow-up and no final determination was made for those teachers expressing intent. Seven teachers were actually teaching, and sixteen expressed the intent to begin soon. A final determination of those teachers expressing intent would have been valuable, though this study has perhaps carried follow-ups over a longer period of time than is the custom with in-service training programs for teachers.

Though the value obtained was down a bit from those indicating a willingness to teach the innovation again, slightly over 74% of the respondents still in their positions during the following year may be considered to be still teaching the innovation.

Suggestions for Further Study

At the outset the investigator conceived of the amount of time spent in teaching the unit and the quality (fidelity to model) with which the teaching was done as critical indicators of the success of the implementation.

Findings in this study do not offer any solid basis for specifying the functions which time taught and quality, independently, play in evaluation of the implementation. Future study of the total effectiveness of an implementation should, among other things, focus on the relative contributions of time taught and quality of implementation to some external criterion for achievement.

For many reasons a clear test of the contribution that collaboration training makes to implementation was not achieved in this study. The study should be repeated with considerably more attention given to what should be involved in this kind of training. In order to sort out the theorized effect of collaboration training, a study should be designed to insure that the training received by the experimental and control groups in fact differs significantly in relation to collaboration skills practice. Care should be taken to insure that the trainees are aware that task facilitation is the goal of this training, and that the collaboration trained for is clearly related to and consistent with the content of the science unit and the teaching model presented.

A third area which should be examined more carefully through future study is observer training. A better balance must be achieved between pre-structuring observation so that data on the outcome indicators can be collected, while at the same time keeping the format open so that sensitive and skilled observers are able to provide judgmental data concerning the quality of implementation.

Summary

The findings of the study indicate that the hypotheses have yet to be conclusively tested. Nevertheless, valuable information for the design of future studies has been gained. Perhaps the most important outcomes are that:

(1) Regardless of selection and training conditions employed, implementation at some level occurred in all treatment conditions; all teachers taught the program.

(2) Setting an implementation criterion and then examining how many people achieve or exceed it is a useful way for monitoring development in a system.

(3) Contrary to expectation, a higher proportion of isolates met or exceeded criteria than did dyads.

(4) Collaboration training had no discriminating effect on the implementation criteria.

Information gained in the course of the field study indicates that, for future studies along these lines, some changes are called for in:

(1) The design of collaboration training.

(2) The design of observer training.

(3) The number and assignment of observers.

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APPENDIX A

IMPLEMENTATION OBSERVATION FORM

DATE ______________

OBSERVER ______________________________

TEACHER OBSERVED ______________________________

TIME ENTERED ______________

TIME LEFT ______________

MINUTES TAUGHT WHILE OBSERVED ______________

MINUTES REPORTED TAUGHT AND NOT OBSERVED ______________

MATERIALS USED DURING LESSON (LIST):

INTERACTION WITH TEACHER (LIST IN DETAIL COMMENTS OR QUESTIONS PUT TO YOU BY THE TEACHER, ALONG WITH REPLIES MADE BY YOU):

MAKE ANY COMMENTS YOU CAN REGARDING THE ATMOSPHERE OF THE CLASSROOM DURING THE LESSON:

IMPLEMENTATION OBSERVATION FORM (CONTINUED)

GROUP MEMBERS ONLY:

1. HOW MANY MINUTES HAVE YOU SPENT DISCUSSING THE INNOVATION WITH YOUR PARTNER IN THE LAST WEEK?

2. WITH WHOM ELSE HAVE YOU DISCUSSED THE INNOVATION IN THE LAST WEEK, AND FOR HOW MANY MINUTES WITH EACH PERSON?

3. HOW MUCH TIME HAVE YOU SPENT IN PREPARING TO TEACH THE INNOVATION IN THE LAST WEEK, IN MINUTES?

4. HOW MUCH TIME HAVE YOU SPENT IN MINUTES IN THE LAST WEEK TEACHING THE INNOVATION WHILE THERE WAS NO OBSERVER PRESENT?

ISOLATES ONLY:

1. WITH WHOM HAVE YOU DISCUSSED THE INNOVATION IN THE LAST WEEK, AND FOR HOW MANY MINUTES WITH EACH PERSON?

2. HOW MUCH TIME HAVE YOU SPENT IN PREPARING TO TEACH THE INNOVATION IN THE LAST WEEK, IN MINUTES?

3. HOW MUCH TIME HAVE YOU SPENT IN MINUTES IN THE LAST WEEK TEACHING THE INNOVATION WHILE THERE WAS NO OBSERVER PRESENT?

ADDITIONAL OBSERVER COMMENTS:

APPENDIX B

SEMANTIC DIFFERENTIAL

____

The purpose of this study is to measure the meanings of certain concepts to various people by having them judge the concepts against a series of descriptive scales. In taking this test, please make your judgments on the basis of what these concepts mean to you. On each page of this booklet you will find a different concept to be judged and beneath it a set of scales. You are to rate the concept on each of these scales in order. Here is how you are to use these scales:

If you feel that the concept at the top of the page is very closely related to one end of the scale, you should place an "X" as follows:

fair __X__:_____:_____:_____:_____:_____:_____ unfair
or
fair _____:_____:_____:_____:_____:_____:__X__ unfair

If you feel that the concept is quite closely related to one or the other end of the scale (but not extremely), you should place your "X" as follows:

strong _____:__X__:_____:_____:_____:_____:_____ weak
or
strong _____:_____:_____:_____:_____:__X__:_____ weak

If the concept seems only slightly related to one side as opposed to the other side (but not really neutral), then you should mark as follows:

active _____:_____:__X__:_____:_____:_____:_____ passive
or
active _____:_____:_____:_____:__X__:_____:_____ passive

The direction toward which you mark, of course, depends upon which of the two ends of the scale seem most characteristic of the concept you are judging. If you consider the concept to be neutral on the scale, both sides of the scale equally associated with the concept, or if the scale is completely irrelevant, unrelated to the concept, then you should place your "X" in the middle space:

safe _____:_____:_____:__X__:_____:_____:_____ dangerous

(Continued on Page 128)

IMPORTANT:

1. Place your "X" in the middle of the space, not on the boundary:

```
                                X
_____:_____:_____:__X__:_____:_____:_____
                  THIS    NOT THIS
```

2. Be sure you mark every scale for every concept -- do not omit any.
3. Never put more than one "X" on a single scale.
4. Do not look back and forth through the items. Do not try to remember how you checked similar items earlier in the test.
5. Make each item a separate and independent judgment.
6. Work at a fairly high speed through this test. Do not worry or puzzle over individual items. It is your first impressions, the immediate feelings about the item, that we want. On the other hand, please do not be careless, because we want your true impressions.

WHEN YOU HAVE COMPLETED THE TEST, YOU ARE INVITED TO COMMENT ON YOUR FEELINGS ABOUT THE TEST IN GENERAL, OR ABOUT SPECIFIC CONCEPTS (AT THE TOP OF EACH PAGE) OR SCALES (THE BIPOLAR ADJECTIVE PAIRS) IN PARTICULAR. THE LAST PAGE OF THE TEST IS LEFT BLANK FOR YOUR COMMENTS.

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CONCEPTS TO APPEAR
AT THE TOP OF THE
THREE SUCCEEDING PAGES:

1. HOW ELEMENTARY SCIENCE SEEMS TO TEACHERS
2. HOW S.C.I.S. SEEMS TO TEACHERS
3. HOW S.C.I.S. SEEMS TO CHILDREN

SCALES TO APPEAR BELOW EACH OF
THE ABOVE CONCEPTS ON THE THREE
SUCCEEDING PAGES:

rigid _____:_____:_____:_____:_____:_____:_____ flexible

hard _____:_____:_____:_____:_____:_____:_____ easy

significant _____:_____:_____:_____:_____:_____:_____ insignificant

naive _____:_____:_____:_____:_____:_____:_____ sophisticated

girls _____:_____:_____:_____:_____:_____:_____ boys

contrived _____:_____:_____:_____:_____:_____:_____ natural

rational _____:_____:_____:_____:_____:_____:_____ irrational

loud _____:_____:_____:_____:_____:_____:_____ quiet

indirect _____:_____:_____:_____:_____:_____:_____ direct

strong _____:_____:_____:_____:_____:_____:_____ weak

sensible _____:_____:_____:_____:_____:_____:_____ magic

convergent _____:_____:_____:_____:_____:_____:_____ divergent

dull _____:_____:_____:_____:_____:_____:_____ stimulating

secondary _____:_____:_____:_____:_____:_____:_____ primary

haphazard _____:_____:_____:_____:_____:_____:_____ guided

dependent _____:_____:_____:_____:_____:_____:_____ autonomous

changing _____:_____:_____:_____:_____:_____:_____ permanent

fundamental _____:_____:_____:_____:_____:_____:_____ derived

(Continued on Page

intuitive _____:_____:_____:_____:_____:_____:_____ logical

teachable _____:_____:_____:_____:_____:_____:_____ unteachable

capricious _____:_____:_____:_____:_____:_____:_____ reliable

frustrating _____:_____:_____:_____:_____:_____:_____ satisfying

expensive _____:_____:_____:_____:_____:_____:_____ cheap

imaginative _____:_____:_____:_____:_____:_____:_____ unthinking

concrete _____:_____:_____:_____:_____:_____:_____ abstract

learnable _____:_____:_____:_____:_____:_____:_____ incomprehensible

wasteful _____:_____:_____:_____:_____:_____:_____ productive

unplanned _____:_____:_____:_____:_____:_____:_____ planned

complex _____:_____:_____:_____:_____:_____:_____ simple

success _____:_____:_____:_____:_____:_____:_____ failure

ordinary _____:_____:_____:_____:_____:_____:_____ challenging

orderly _____:_____:_____:_____:_____:_____:_____ messy

inconclusive _____:_____:_____:_____:_____:_____:_____ definitive

unstructured _____:_____:_____:_____:_____:_____:_____ structured

telling _____:_____:_____:_____:_____:_____:_____ listening

impractical _____:_____:_____:_____:_____:_____:_____ practical

APPENDIX C

PERSONAL INFORMATION SHEET

DATE ______________________

TEACHER ____

TEACHER'S AGE ________ YEARS ________________________ MONTHS

YEARS OF EXPERIENCE AT EACH OF THE FOLLOWING LEVELS, TO INCLUDE FULL-TIME PRACTICE TEACHING OR OTHER EXPERIENCE PRIOR TO FULL CERTIFICATION (Estimate to the nearest one-half year.):

NURSERY ______________________________

KINDERGARTEN ______________________________

GRADE ONE ______________________________

GRADE TWO ______________________________

GRADE THREE ______________________________

GRADE FOUR ______________________________

GRADE FIVE ______________________________

GRADE SIX ______________________________

ANY HIGHER LEVEL ______________________________

NON-GRADED SITUATIONS (Give ages of children involved.)

____

____

____

PLEASE MAKE A BRIEF STATEMENT GIVING YOUR HOBBIES OR OTHER SPARE-TIME INTERESTS:

APPENDIX D

A YARDSTICK FOR MEASURING THE GROWTH OF A PAIR - - -

As a pair begins its life and at several points during its growth, the pair partners might reflect on the following scales and spend some time sharing the data that is collected. Through these scales, it is possible to get a general picture of the perceptions which partners have about the pair and how it is growing. It is also possible to pick up areas in which there may be some difficulties which are blocking progress.

1. How clear the the pair goals?

1.	2.	3.	4.	5.
No apparent goals	Goal confusion, uncertainty, or conflict	Average goal clarity	Goals mostly clear	Goals very clear

2. How much trust and openness in the pair?

1.	2.	3.	4.	5.
Distrust, a closed team	Little trust, defensiveness	Average trust and openness	Considerable trust and openness	Remarkable trust and openness

3. How sensitive and perceptive is my pair partner?

1.	2.	3.	4.	5.
No awareness or listening in the pair	Partner self-absorbed	Average sensitivity and listening	Better than usual listening	Outstanding sensitivity to others

4. How sensitive and perceptive am I?

1.	2.	3.	4.	5.
No awareness or listening in the pair	Myself self-absorbed	Average sensitivity and listening	Better than usual listening	Outstanding sensitivity to others

5. How much attention was paid to process? (The way the pair was working?)

1.	2.	3.	4.	5.
No attention to process	Little attention to process	Some concern with pair process	A fair balance between content and process	Very concerned with process

(Continued on Page 82)

6. How was pair leadership needs met?

1.	2.	3.	4.	5.
Not met, drifting	Leadership concentrated in one person	Some leadership sharing	Leadership functions distributed	Leadership needs met creatively and flexibly

7. How were pair decisions met?

1.	2.	3.	4.	5.
No decisions could be reached	Made by one member	Initial agreement	Attempts at integrating both views	Consensus

8. How well were pair resources used?

1.	2.	3.	4.	5.
No use of pair resources	Each tried to contribute, but were discouraged	Average use of pair resources	Pair resources well-used and encouraged	Pair resources fully and effectively used

9. How much loyalty and sense of belonging to the pair?

1.	2.	3.	4.	5.
Members had no pair loyalty or sense of	Members not close but some friendly relations	About average sense of belonging	Some warm sense of belonging	Strong sense of belonging between partners

(This instrument was developed by Howard Williams, Billy Alban, and Charles Seashore.)

APPENDIX E

FOLLOW-UP SHEET

NAME ______________________

DATE ______________________

AN EXPERIMENTAL SCIENCE PROGRAM FOR FIRST GRADERS IN DISTRICT 29, QUEENS

This sheet is given as a chance for you to let me know how you presently feel about the science unit and the way in which it has affected your children, you, and your school.

1. The average number of minutes I have taught per week when
   a. Observer was not present. ________
   b. Number of times taught per week. ________
   c. How many minutes taught each time (average). ________
2. Average preparation time per week, in minutes; we need to know how much "extra" work is required to teach the unit. ________.
3. When did you last teach a lesson? (date) ______________________

   Which lesson was it? ______________________________
4. How comfortable do you feel with the content of the unit?

   0 1 2 3 4 5 6 7 8 9 10

   Uncomfortable   Indifferent   Very Comfortable
5. The response of my class to the unit: (Check one.)
   a. Materials too difficult.
   b. Slight interest in the activities.
   c. High interest in the activities.
6. My willingness to teach the unit again next year:
   a. Not interested.
   b. Interested, if consultant help is given.
   c. Interested, if I have help or support inside the school.
   d. Definitely intend to use the unit, even if on my own.
7. Are there any materials which would need to be replaced? Specify.

Appendix E (Continued)

8. What has been the response of other teachers in your school?

9. What changes would you suggest in the lessons?

10. My overall feeling about the project. (Use other side if you like.)

Please check the activities which you have taught:

1. OBJECTS IN THE CLASSROOM
2. OBJECTS COLLECTIONS (paper bag + objects)
3. AN OBJECT HUNT
4. OBSERVING PLANTS
5. GRANDMA'S BUTTON BAG
6. OBSERVING LIQUIDS
7. ROCK CANDY AND LUMP SUGAR
8. EXPERIMENTING WITH LIQUIDS AND MIXTURES
9. SOLID AND LIQUID WATER
10. FLOATING AND NON-FLOATING OBJECTS
11. EXPERIMENTING WITH AIR
12. EXPERIMENTING WITH AIR AND WATER

APPENDIX F

TEACHER'S GUIDE

"AN EXPERIMENTAL SCIENCE PROGRAM FOR FIRST GRADERS IN DISTRICT 29, QUEENS"

____

____

Reprinted from Material Objects Teachers Guide

by Science Curriculum Improvement Study

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This Guide was adapted from materials developed by the Science Curriculum Improvement Study, University of California, Berkeley.

GENERAL INTRODUCTION AND BACKGROUND

In 1959, with financial support from the National Science Foundation, a group of scientists and educators at the University of California, Berkeley, began a study for course content improvement in elementary school science. From this group there evolved in 1961 the Science Curriculum Improvement Study, which set out to produce a sequential, articulated science program for the elementary school. To accomplish this goal, the SCIS staff began an exploratory teaching program in several San Francisco Bay Area schools. Feedback from the exploratory teaching was of great help in devising coordinated packages of teachers' manuals, students' manuals, and kits of equipment and audiovisual aids, which were then used by other elementary school teachers for several years. Other units will become available each year in a sequence which builds on the experiences in previous units and lays the groundwork for the following units.

The Science Curriculum Improvement Study is attempting to produce a program which both guides the child's development in his experience with natural phenomena and provides him with the necessary conceptual framework in which to view such experiences. The immediate goals of the program are to acquaint a child with specific examples of objects and organisms, to let him investigate examples of natural phenomena, and to help him develop skills of manipulating equipment and recording data. The long-range goals of the program are to contribute to the intellectual development of the child and to increase the scientific literacy (i.e., the functional understanding of basic scientific concepts) of the school population and hence the adult population.

The approach and goals of the Science Curriculum Improvement Study can be summarized as follows:

(1) the evolution of a sequential, articulated elementary school science program based upon the structure of science as seen by scientists today;
(2) the conversion of the elementary school classroom to a science laboratory in which the children individually and in small groups can gain first-hand experience with natural phenomena;
(3) the changing of the teacher's role from a mere lecturer (who tells the child what he should know) to an individual who attempts to analyze and synthesize experience in order to develop generalizations and understandings;
(4) the enhancement of the learning process as a child progresses from thinking in concrete terms to thinking in abstract terms.

OVERVIEW OF THE UNIT

The concept that matter exists and has properties is one of the first abstractions the child is able to understand and deal with. In this unit he begins to learn to apply this basic concept.

MATERIAL OBJECTS introduces the child to the fundamental concepts of objects and their properties. It leads him to manipulate, describe, compare, and change the form of samples of various solids, liquids, and gases.

The main objective of the unit is to teach the child to recognize material objects in his own environment. The objects themselves are to be distinguished from their properties. The range of objects used is as broad as conveniently possible. The pupil observes and manipulates rigid, well-defined objects such as rocks and twigs, samples of liquid such as glycerin in a jar, living organisms, and samples of gas such as air in a balloon.

For contrast, you should consider what would not be objects in this sense. All abstractions such as love and hate, time and space, beauty and color, hunger and thirst, are examples of things that are not material objects. The word THING, which can be used to refer to abstractions, has too broad a meaning to be useful in a science program which tries to communicate a concept of matter. The contrast between OBJECTS and NONOBJECTS is introduced in later units; in this unit, the child becomes acquainted with the objects in his environment and merely distinguishes the objects from their properties.

The child is allowed to carry out experiments in which he collects evidence about the material of which lump sugar and rock candy are composed, tests whether objects float or sink in water, and uses air to displace water from submerged containers. These experiments give the child opportunities to experience various material objects and their properties; the experiments also provide an informal introduction to the concept of SYSTEMS, which is the subject of a later physical science unit in the SCIS program.

While dealing with material objects in this unit, the child will develop various attitudes, abilities, and skills, including habits of careful observation, a vocabulary that is useful in describing objects, methods of recording observations and experiences, and the ability to discriminate fine differences and to recognize broad similarities.

Hopefully each child will have many and varied experiences in:

(1) manipulating and observing different kinds of objects;
(2) describing the properties of observed objects;
(3) acting upon and experimenting with objects in the solid, liquid, and gaseous phases;
(4) using certain tools such as a magnifier, a mortar and pestle, and a medicine dropper;
(5) keeping a record of observations;
(6) working with other children as part of a team.

Your frequent use of the question: "What is your Evidence?" can help the children in many ways. Whenever a child makes and reports an observation, draws an inference, or states a conclusion, you should ask this question or a similar one. The child's answers will help you analyze and evaluate his ability to observe and/or manipulate objects and to use his observations in making decisions. In addition, as different children report varying evidence while observing and manipulating similar objects, you will have excellent opportunities for promoting pupil-to-pupil discussions about the evidence. With your guidance, these discussions can lead the children to decide that they need to obtain further evidence to settle the controversies. Situations such as these will increase the child's interest and involvement in the concrete operations which are at the core of this unit.

PART ONE

INTRODUCING OBJECTS AND THEIR PROPERTIES

INTRODUCTION

Through all of our senses, we become familiar with and learn to recognize objects in the world around us. Perhaps as children we examined each newly discovered object with great interest, but as adults we have become so accustomed to most objects that we no longer examine them very carefully.

Children can recognize and name many objects by the time they enter school. On their level of awareness, however, there may not be a conscious distinction between the object and a phenomenon or activity in which it is involved. Usually, young children have only a limited variety of experience with any one object. For example, the child sees a flat, smooth stick about six inches long and immediately thinks of popsicles rather than wood.

To a certain extent, the child's limited patterns of association help him to get along in his immediate environment; but an adult must have more flexible patterns of association. The study of science helps develop rational and flexible thinking patterns.

THE OVERALL OBJECTIVE OF PART ONE IS TO MAKE THE CHILDREN MORE AWARE OF THE MATERIAL OBJECTS IN THEIR ENVIRONMENT. The objects themselves are to be distinguished from their properties (shape, color, texture, size, etc.), from the influence or effect they have on one another, from the patterns in which they may be arranged, and from the emotions they arouse. In the first three activities we shall concentrate on the properties of objects.

These ideas about objects can be illustrated by consideration of a lake. The matter or material object is a certain body of water. This may be thought of as one entity (the lake), or it may be thought of theoretically as composed of a vast number of water molecules. The name "lake" applied to the body of water implies a certain flat and spread-out shape. The waves on the surface are not objects in addition to the water in the lake but are arrangements of the drops or molecules. The dirt in the lake is made up of foreign objects present in the lake. The plants and animals in the lake are objects. The gases mixed in the water are objects also; but the beauty of the lake, the reflections on its surface, and the pleasure of swimming are not material objects.

Other objectives of this unit include developing habits of careful observation, developing the abilities to discriminate fine differences and to recognize broad similarities, and developing a vocabulary that is useful in describing objects. The approach is based on giving the children many objects to observe and manipulate. Some objects are included in the equipment kit, and other objects of interest to the children can be added by you or by the children themselves.

In this unit the children will learn to understand and use the word OBJECT as a term for referring to a piece of matter. The primary emphasis is upon the properties of objects rather than their functions. You should introduce the word PROPERTY to the children and use it as you call their attention to the color, shape, texture or other characteristics of the object. With your guidance, the word PROPERTY will become a useful word in their work and in their discussions with you and with other children.

Activity 1: OBJECTS IN THE CLASSROOM

Objectives of the Learning Experiences

Uses the term OBJECT for a piece of matter and the word PROPERTY for any characteristic of that piece of matter.

Identifies and describes material objects by their properties, not by their use.

Teaching Suggestions

The first lesson on material objects should be rather informal. Present a number of objects such as blackboard erasers, rocks, chairs, goldfish, etc., which are in the classroom, and ask the children to tell you about them. Use the term "object" in talking with the children.

The children will probably describe the uses of an object in addition to or instead of its properties (shape, color, texture). Accept statements related to use, but encourage concentration on properties by questions such as, "Yes, we use the chalk to write. What can you tell me about the chalk that lets us write with it?" Spend only a short time on any single object, since the children may have difficulty describing objects by properties and may have to resort to describing the function of the object. Choose a wide variety of objects. Using a chart headed "Words We Use to Describe Properties of Objects" is a good way to help children develop a working vocabulary as they talk about objects and their properties. Words should be added to the chart only after they come up in the class discussion. No attempt should be made at this time to establish a formal definition of the word "object." For the present, it is sufficient that the definition is implied by your referring to a concrete object which is present in the classroom. Use the word "property" in your discussion of answers to questions such as "What is the color of this object?" or "Is this object rough or smooth?" or "What is the shape of this object?" This encourages the children to think about properties. In later activities, the children should begin to use the word "property" as the objects are described.

Give the children the opportunity to choose and describe objects in the classroom. Use one or more of the simple "object games" outlined below. Make up others that seem appropriate for your class.

Games with Objects in the Classroom

1. A child is chosen as the leader and whispers to you the name of an object in the room. The leader then tells the class in which part of the room (front, back, by a window) the object is located and gives the class clues about the object (its properties) without revealing its name. After each clue, the children in the class are given the opportunity to guess what object the leader is talking about. It is best to allow only one or two guesses after each clue and to permit a single

child to make only one guess for each object chosen; this will help encourage the children to concentrate on the clues instead of simply guessing at random. The first pupil to correctly guess the name of the object becomes the next leader.

2. The teacher or a leader holds up an object. Children who correctly name a property of the object may stand up. Standing pupils are counted as a means of showing how many properties of the object were named.

3. For variety, play object games with small groups of children while others are doing individual work. Gather some boys in a group and play "Pocket Objects." Each boy transfers all but one object from one of his pockets. Then, while holding his hand on the object in his pocket, he gives clues to the rest of the group. The first one to name the object correctly gets the next turn to choose a pocket object. In each round a child is allowed only one guess.

Suggested Use of the Property Chart

The list of words on the chart described in this lesson may grow to fifteen or thirty before you are through. These words will probably be added in random order. After a few weeks this list should be re-examined by you and your class. Read the words as you point to them. Let the children group the words on the chart under headings such as "Texture Words," "Color Words," "Size Words," "Shape Words," "Weight Words," etc., which suggest some of the ways in which these words may be grouped by property. After they do this, repeat the words and discuss how the children have grouped them. Explain that each group of words tells about one property of an object. New property words can be added to the list during the rest of the unit. You may wish to make a separate chart for each group of property words, leaving adequate room for words to be added later.

NOTE: Some children will make obvious errors in identifying properties. A red bead may be called yellow, for example. Such errors should be corrected not only by substituting the correct word but also by presenting two objects which show the difference (perhaps a red bead and a yellow block, in this case). If a group of children are generally confused about the meanings of simple property words such as "red," "square," "smooth," etc., you should note this and give them further experience in this area, either in this activity or in subsequent ones. The children's reactions to the objects you provide are most valuable in helping you diagnose their learning strengths and weaknesses.

Notes

Activity 2: OBJECT COLLECTIONS

Objectives of the Learning Experiences

Describes a collection of objects by their properties.

Sorts objects by a chosen property.

Teaching Materials

For every two children:

1 paper bag containing:
- cellulose sponge
- cork
- button
- bean
- balloon
- piece of wood
- rubber stopper
- 3" x 5" card
- rock
- calico clam shell
- thumbtack
- rubber band
- aluminum rod
- crayon
- piece of wooden dowel
- paper clip
- marble
- wooden stirrer
- aluminum foil
- plastic spoon
- bag of wood shavings
- lock nut (rubber center)

Teaching Suggestions

Place one of the closed bags of objects from the kit in front of each pair of children. Ask them not to look inside yet, but to tell you about the objects (the bags) you have placed in front of them. They may describe the color, shape, and possibly even the texture of the bags. Then let them open the bags and examine the contents for four or five minutes. Ask each child to select one object from the bag, and ask for volunteers to show their objects to the group and tell about the properties of the objects.

Pick up one object from your bag and ask each pair of pupils to choose a similar object from their bag. Call on a child to tell you about properties of the object he has chosen. If the child has difficulty in describing his object, read to him some of the words from the properties chart started in Activity 1. On the board or on the chart, list the properties mentioned. Repeat this with several pupils. Choose other objects from your bag in order to develop an extensive list of properties from the responses of the children. When you feel (after one or more sessions of this type) that they have the ability to describe properties of objects, proceed to the following simple exercise in sorting objects by properties.

Name a property (color or shape, for example) and ask each pair of pupils to group some or all of the objects from their bag into piles on their desks while thinking of this property. Let them describe how the objects in their piles differ from one another. If they cannot sort or describe the objects at this time, do not become concerned. There are future activities which will help develop this ability to categorize objects by properties, which is difficult for some children.

The day-to-day science work in the classroom can consist of any activity that helps children become aware of objects and their properties. How many sessions should be spent on this activity depends upon the needs and abilities of your particular children. If some children have trouble sorting, choose a very simple property such as "red" and have these children select all red objects. Then ask them to sort blue and green objects. Point out to the children that they have now sorted objects into three groups according to color. It is not necessary to use all the objects in the bag the first time you have a sorting session. If some children still have trouble understanding sorting, you should help and encourage them to sort objects found in the classroom, in their pockets, or brought from home.

Activity 3: AN OBJECT HUNT

Objectives of the Learning Experiences

Identifies properties of objects collected on a hunt.

Sorts objects, using one property.

Teaching Materials

For each child:

1 paper bag
2 cardboard trays (Note: Retain cardboard trays for use in subsequent MATERIAL OBJECTS activities.)

Teaching Suggestions

The children's interest and practice in identifying and grouping material objects will be extended to objects outside the classroom by means of collecting objects on a field trip around the school or to a park.

For the hunt, choose a route or area that will provide the greatest possible variety of objects suitable for collection. In order to avoid influencing the children's choices, you should make your own collection of objects (which will be used later for discussion) prior to the class trip.

When you and the children have reached the area chosen for the hunt, give each child a bag. Tell them that they may each choose and collect up to ten objects, and emphasize that each should work individually and try to collect a variety of objects. Again, so as not to influence the children's choices, restrict your remarks to interesting objects that cannot be collected. Point out the fact that birds, trees, buildings, and clouds are objects. Such remarks may inspire some children to collect feathers, leaves, and bits of brick.

After returning from the hunt, give each child two cardboard trays, and allow the children to spread their objects out and examine them for a few minutes. Tell them to think of one property and to sort the objects accordingly. Ask one child to tell and show how he sorted his objects; as he reports, write on the board the property used for sorting. This method of sorting can then be used by everyone to sort his own objects. Call on other children and follow the same procedure. Some objects may be placed in an "undecided" group. This "undecided" category may cause a little discussion, which should be encouraged.

After sorting the objects from the hunt, put out trays with appropriate labels chosen from the ones suggested by the children during the sorting -- for example, "smooth," "brown," "stickery," "undecided," "crunchy," and "bumpity." Give each child an opportunity to place one or more of his objects on an appropriate tray and encourage discussion among the children about their bases for sorting. Ask questions about the objects in the "undecided" group in order to encourage discussions about the properties of these objects. If children have difficulty selecting properties for grouping, you may suggest a way to group their objects -- for example, by color.

If you repeat the field trip or object hunt at different times of the year, this will extend the children's experiences concerning objects whose availability or appearance are subject to seasonal changes. In the fall, a variety of leaves may be collected. Seeds and fruits also provide interesting groups of objects for study. In the spring, flowers can be collected as objects to study.

Another way of using the outdoor classroom is to go on a "Property Hunt." Divide the class into groups, and let each group select a property. They then collect only objects which have that property and display them with an appropriate title in the classroom.

An outdoor activity in addition to or that might precede those described above is the "Object Walk." To acquaint the children with the vast array of objects in their environment, it is useful to take walks during which objects are observed and described but not collected.

When you discard the objects found on the hunts, place the trays with the children's labels in the science corner of the room. Encourage the children to bring in appropriate objects to place on the trays, and give them opportunities to display and tell about the objects collected on their personal hunts.

You can individualize the suggested activities to meet the learning needs of different groups of children. For example, a group of children who are adept in sorting can work with the "undecided" group of objects; another group which is confused can repeat the sorting of the objects which were grouped earlier, after you have scrambled them.

Activity 4: OBSERVING PLANTS

Objectives of the Learning Experiences

Describes properties of an entire plant.
Describes properties of parts of plants thought of as objects.
Notes similarities and differences among plants.

Teaching Materials

For demonstration purposes:

Potted plants such as cactus, coleus, African violet, geranium, ivy, philodendron*
Aquatic plant, such as goldfish greens (elodea), in an aquarium or large jar filled with water*
*(All plants are to be provided by the teacher.)

Teaching Suggestions

The observation of plants can be spread over several weeks, while other activities are in progress. In this activity, use several five-to-ten-minute sessions to focus the children's discussion on one plant per session. After this activity, keep the plants in your classroom so the children will be able to observe and discuss changes that take place. It will be helpful if you choose plants that are easy to obtain and care for.

One of the brief sessions can begin as you hold up one of the plants and ask a child to describe it. If possible, carry out this part of the activity at various times with small groups of children rather than with the whole class. For example, use the plant as a topic for discussion with one of the reading groups in your class. Let the children feel and smell the plant to get more information. The children may tell you about the entire plant, or they may tell you about parts such as leaves, flowers, stems, etc. Encourage them to be specific as to what they are describing in their statements. Point out that each part of the plant may be thought of as an object.

Compare each new plant with those discussed earlier. The order in which you discuss the individual plants does not matter. The aquatic plant, however, is a little more unusual for the children and can perhaps be best taken up near the end of the series; it can then be contrasted effectively with the land plants.

After you return the plants to their places in the room, ask the children what differences they may be able to observe about these plants after a few weeks. If your pupils say the plants may have grown, try to devise a way in which you and the children can prove that the plants do grow. For example, a piece of paper or cardboard which is placed behind the plant and on which the appropriate outline of the plant is traced can provide a record of the present "profile" of the plant. As time passes, the children can make new profiles to compare with those made earlier.

Activity 5: GRANDMA'S BUTTON BAG

Objectives of the Learning Experiences

Sorts objects by size, shape, color, or other properties.

Groups objects according to different properties chosen by the teacher.

Teaching Materials

For each child:

a handful of approximately 30 assorted buttons
1 cardboard tray

Teaching Suggestions

Give each child a handful of buttons from the kit. After you and the class have discussed the properties of the buttons, and their similarities and differences, suggest to the children that they sort their button collections by color. They should choose their own methods and number of groups. For example, some may make one pile of red buttons and another pile of all others; others may separate each individual color into a different pile; some may even separate by the shade of color. All these choices are correct and should be accepted. Encourage individual pupils to describe the ways in which they sorted their collections.

After you have completed the discussion of color sorting, ask the children to sort their buttons by a property other than color. The number of groups and the properties they use in sorting should again be left completely to the pupils. Offer suggestions only if a child seems very confused. When they have finished sorting in this way, ask a few children to describe the ways in which they sorted and let other children look at the groups being discussed. This activity can be carried out more than once, and you may also want to let the children return to it at a later date.

Another way of using the buttons is to have the children make specified numbers of groups, say, first one, then two, then three ..., on the basis of whatever properties they choose. Again, ask several children to tell you what properties they used to make their groupings.

NOTE: If a child has trouble sorting his collection of buttons, try giving him only eight or ten buttons to sort during another session. Let the children have access to the buttons so that interested individuals or groups can continue to sort them during free periods in the day, to improve their method of sorting.

Activity 6: OBSERVING LIQUIDS

Objective of the Learning Experience

Describe properties of different liquid samples.

Teaching Materials

For each group of four children:

4 liquid samples in screw-top vials, 1 each of:
- water
- glycerin
- motor oil
- liquid starch with bluing

For each child:

- 1 sheet of pastic
- 1 cardboard tray
- 1 disposable medicine dropper

Teaching Suggestions

Give each team of four children a set of the four liquids in vials. (The children should not yet take off the caps.) After the children have manipulated the vials and observed the liquids for a while, ask them to describe some properties of the liquids and to make comparisons among the liquids. Encourage the children to name properties that other children or teams have not yet thought of. Ask teams to group their liquids by property; let the children describe their own team's grouping, and let other children question these groupings.

For the concluding experience of this activity, give each child a sheet of plastic, which should be placed in his cardboard tray. Tell the children to carefully place (with the medicine dropper) a few drops of each of the four liquids in different places on the plastic in the trays. If one dropper is always used for the same liquid, the liquids will not be mixed in their vials. If each child prefers to use his own dropper on all four liquids, be sure that he does the oil last. (The members of a team will be sharing the contents of their vials.) This will give the children an opportunity to feel and smell the liquids instead of merely looking at them. The children can use their fingers to spread the liquids around on the plastic sheets; they may also mix the liquids, if they wish. Discuss with the children the fact that each liquid is apparently made of only one material. When this activity is completed, the children should wash their hands and then walk around the room to observe other children's trays.

Most of the used plastic sheets can be thrown away, but you should set aside some trays which contain liquids that have not been mixed.

These should be left uncovered someplace in the classroom where the children can observe them over a period of several days. Encourage the children to predict what will happen to each of these liquids, and record their predictions on a chart. Later, compare the predictions to the observations; the observed changes can stimulate further discussions about the properties of the liquids.

PART TWO

EXPERIMENTING WITH MATERIAL OBJECTS

INTRODUCTION

IN THIS CHAPTER THE EMPHASIS IS ON THE CHILDREN'S ACTING UPON THE OBJECTS THEY ARE OBSERVING. Not much sorting will be done, but properties of objects and the concept of material will continue to be important considerations as the children test and change the form of objects.

The children have had many experiences with living and non-living objects; describing their properties, comparing them, and considering their material or make-up. Most of those objects were solids. In this chapter, the children will primarily study liquids and air and will learn to regard samples of liquids or gases, as well as solids, as being material objects.

By now, your familiarity with the SCIS methods of developing science concepts should be giving you the experience and confidence to devise means to further stimulate the children's interest in science. Evidence of your own interest in these activities, demonstrated by your search for other interesting objects and situations to present to the class, will enhance the children's interest in these activities. Encourage the children to investigate further and explore variations of the activities described in this chapter.

Activity 7: ROCK CANDY AND LUMP SUGAR

Objectives of the Learning Experiences

Recognizes that the material of an object may remain the same, even though the object's appearance changes.

Recognizes that two objects may appear to be different but are still made of the same material.

Background Information

Objects that appear different in form may be made of the same material; wood pieces, shavings, and dust may be made of the same kind of wood. In this activity, pieces of sugar will be ground into smaller and smaller pieces; though they change in appearance, they are still made of the same material.

Please note that the sugar cube, the granulated sugar, and the powdered sugar are all solids. Though at first it may seem inaccurate to call the powder a solid, of course you could not call it a liquid or a gas. Also note that the smaller pieces of sugar, even the tiny particles, are objects. This is another instance where parts of objects may be thought of as objects.

Teaching Materials

For each group of four children:

2 or more cubes of sugar
2 or more pieces of rock candy (approximately the size of a sugar cube)
2 cardboard trays
2 wooden stirrers
2 paper towels (to be provided by the teacher)
1 mortar and pestle
4 magnifiers

Teaching Suggestions

The children will work in teams of four. Give each team two trays, two cubes of sugar, and two pieces of rock candy, and suggest that the children use their magnifiers to examine both kinds of sugar. Ask the children to report how these objects appear alike and how they appear different.

Then give each team two wooden stirrers and a mortar and pestle. (If necessary, show them how to do this.) When the cube is broken into smaller pieces, the children should examine these objects and tell each other how the smaller pieces appear to be similar to and different from the sugar cube. Some of these small pieces should be placed on one of the cardboard trays. Then the team members can take turns grinding the rest of the small pieces of sugar into fine powder. With the wooden stirrer, they can scrape the powder onto the same cardboard tray with the small pieces. The mortar and the pestle should be wiped with a dry paper towel to remove any powder that still remains. The team's second sugar cube is placed in the tray with the sugar powder and pieces of sugar.

Each team now goes through the same steps with the rock candy as they did with the sugar cube. Their examination, with magnifiers, of the rock candy as it is broken down is an important part of the experiment. The participation of each child in the grinding process is also important. Using the other stirrer, the children should put the powder and small pieces onto the other cardboard tray along with the second piece of rock candy.

To conclude the session, let each child examine the powder and small pieces on both trays by using a magnifier, by touching, and by rubbing the powder between the fingers. As the children describe the properties of the powdery materials, listen carefully to their language and compare it to the language they used to describe objects at the beginning of the unit. Such informal comparisons will give you information about the growth of the children's abilities during the course of the program.

Activity 8: EXPERIMENTING WITH LIQUIDS AND MIXTURES

Objectives of the Learning Experiences

Orders liquids by property.

Describes changes in a mixture of liquids observed over a period of time.

Describes the properties of many different liquids.

Teaching Materials

For demonstration purposes:

- 1 labeled 8-ounce jar of each of the following liquids:
    - water
    - glycerin
    - motor oil
    - liquid starch with bluing
- 2 one-quart plastic jars
- 1 large chart pad (to be provided by the teacher)
- 1 large stirring dowel

For each group of four children:

- 4 liquid samples in screw-top vials, 1 each of:
    - water
    - glycerin
    - motor oil
    - liquid starch with bluing

Teaching Suggestions

Distribute one set of vials with liquids (identical to those used in the lesson titled "Observing Liquids") to each group of four children, and ask the children to think of ways in which they can order the liquids by property. If no one has any ideas, demonstrate ordering a set by some property such as amount of liquid in the vials. Then let the children try ordering their liquids by other properties.

Following this activity, show the children (who can be gathered in a wide circle for better observation) the set of four 8-ounce jars. You may want to repeat some parts of "Observing Liquids" as an introduction to this activity. Referring to the previous spreading-around of liquids, you can proceed to explore the children's ideas of what happens when the liquids are mixed. After a brief discussion, bring out the two-quart jars and pour into each about one-quarter of the liquid from each of the 8-ounce jars. Let the children observe the combined liquids before you use the stirring dowel to vigorously mix the contents of one quart jar. Let the children describe any change in appearance caused by the stirring; encourage them to compare the stirred jar with the unstirred jar.

Finally, set the quart jars aside in a place where they can be observed over a period of a week or two.

Explain that the remaining liquids in the 8-ounce jars will be the beginning of a museum. Ask the children to bring from home labeled samples of liquid which the class will add to the museum; each child should get the permission of his father or mother before bringing a liquid to school. Suggest that the children bring their liquid samples in small jars such as baby-food jars.

Explain that in the quart jars the children will continue to observe a mixture of many liquids, since each child who brings a liquid will pour some of it into each of the quart jars. (The rest of the liquid in the small labeled jar should be added to the museum.) The child will then stir the contents of one quart jar with the dowel; the other quart jar should not be stirred at any time. To conclude the class session, show the chart paper on which you will keep a record of all the liquids that are in the quart jars and the date when each is added.

As this activity continues, hold occasional discussions on the mixtures in each of the quart jars. The smells, the colors, the number of layers, and other properties may be noted by the children; encourage them also to compare the two jars.

SAFETY NOTE!

The great variety of liquids found in the home makes it difficult to foresee what the children will bring to the museum. It is possible that certain liquids should not be mixed with others that are in the jar. If you are in doubt about a liquid, consult its commercial label to learn what precautions should be taken in working with it. If you are still in doubt, do not add it to the mixtures.

Activity 9: SOLID AND LIQUID WATER

Objectives of the Learning Experiences

Observes a sample of water change from solid to liquid.

Uses the medicine dropper for transferring liquids between containers.

Realizes the relationship between changes in observed properties and a time sequence.

Background Information

The children easily changed solid objects into smaller solid objects merely by grinding. The changing of a solid to a liquid, which is usually more complicated, is simplified when we use ice cubes as the material to be acted upon. Breaking an ice cube into smaller pieces will also permit this change to occur more quickly, because more surface of the solid is exposed to warm air.

The children will watch solid water change to liquid water while using their magnifiers. You should explain little about this change; just let the children make observations and discuss them. This activity serves as a bridge from the study of a solid object to the study of a liquid of the same material. This activity and experiments in later units of the SCIS program will provide the background and experience necessary to enable the children to develop an understanding of the phenomenon of phase change.

Teaching Materials

For each group of four children:

4 plastic dishes
4 medicine droppers
4 plastic teaspoons
2 - 3 ice cubes (to be provided by the teacher)
1 mortar and pestle
1 cardboard tray
4 magnifiers

Teaching Suggestions

Distribute one mortar and pestle and a cardboard tray to each team of four children and briefly review the previous use of the mortar and pestle. Put one ice cube into each mortar and another onto each tray. Direct the children to take turns using the pestles to break up the ice cubes in the mortars. Meanwhile, give a plastic dish and spoon to each child. If pieces of ice fly out, they should be returned to the mortars. Each child should use his spoon to take a small piece of ice out of the mortar and place it on his inverted dish. Using magnifiers, the children should "watch what happens to the ice." A child may report to his team members what he sees under the magnifier, but he should continue to observe his piece of ice. Some of the children may remark that water is forming. When most of these pieces of ice have melted, tell the children to feel in the mortars for other pieces of ice. There may be none, but in this way each child will notice that the water is cold. If some ice does remain, tell the children to grind the pestles around in the mortars until no ice is noticeable.

No organized discussion is suggested for this experiment. However, the children will talk to each other about it. Call their attention to the ice cubes that were placed on the trays, and ask them to examine this part of the trays.

At this time, give each child a medicine dropper. Encourage the children to use these to transfer some of the water from the mortars to their dishes. When the ice cubes have melted on the trays, some of that liquid can also be transferred with the medicine droppers. Young children enjoy using these droppers, so some free play is involved here; meanwhile, they will be gaining experience in handling science equipment. If some children don't know what to do with the droppers, let them learn from their classmates, or show them briefly by using one yourself.

Activity 10: FLOATING AND NONFLOATING OBJECTS

Objectives of the Learning Experiences

Compares different objects in regard to the property of floatability in water.

Keeps a record of observations.

Verifies observations by repeating the activity.

Teaching Materials

For demonstration purposes:

1 one-quart plastic jar
1 one-gallon bucket for waste if no sink is available (to be provided by the teacher)

For every two children:

2 paper towels (to be provided by the teacher)
2 plastic dishes
1 assortment of solid objects in a bag (from Activity 2)

Teaching Suggestions

Whether an object sinks or floats in a liquid depends upon complicated relations that need not be explained in this lesson. However, this lesson implants the seed of a concept that can be germinated later. For now, the children will note only that each test (of whether an object sinks or floats in water) involves both the object and the water.

Tell the children they are going to test objects to see whether they will float in water. Give each pair of children two plastic dishes, paper towels, and the bag of objects to be tested. Then, using the quart jar, fill the plastic dishes half full of water. The children will test in pairs, though each will record his own findings. Explain that the objects are to be tested one at a time, so that only the water and one object will be in the dish together. After each object has been tested, it should be taken out of the dish and placed on the paper towel. Then another object can be tested in the water.

While the testing and recording is going on, you should move from team to team observing the children, listening to their comments, and showing your approval of their work. When most of the objects have been tested, have the teams (with their check sheets) sit near the chalkboard. Go over the findings of each team for several of the objects tested. In a few cases the teams will disagree; an example may be the clam shells, which sink if put into the water in one position but float if put into the water in another position. If a disagreement does occur, allow one of the teams involved in the disagreement to demonstrate with its object to show that it floats, and allow the other team, with its similar object, to demonstrate that it sinks.

Discuss the evidence obtained about the floatability of these objects. After the reports, have the children dry their objects with the paper towels while you pour the water from the dishes into the bucket. If the children's interest is high, this activity can be repeated on another day.

Activity 11: EXPERIMENTING WITH AIR

Objectives of the Learning Experiences

Recognizes that a sample of air may be considered an object.

Observes that air occupies space, takes the shape of the container, and is compressible.

Teaching Materials

For each child:

1 plastic 10 cc syringe
1 clear plastic bag

For demonstration purposes:

2 plastic 30 cc syringes
1 clear plastic bag

Teaching Suggestions

Tell the children to clear their desks. Hold up a flattened plastic bag and ask the children to describe this object. After the group has mentioned a few properties, give each child a plastic bag and tell him to put an object or objects inside. Tell him not to use objects from his desk. Some children will put hands or fingers into the bags, and you should accept these decisions. One or more children will probably trap air in the bag. Encourage the children to mention the properties of the objects they have put into their bags. Check to see if they are able (especially in the case of air) to think of the objects as being separate from the bags. Trap some air in your bag and ask the children to do the same; then discuss the properties of the air in the bag. You or the children should mention the facts that the air is colorless ("see-through color," according to one first-grader), can be squeezed, and takes the shape of the bag. The properties of a bag filled with air should then be contrasted to the properties of another bag filled with solid objects. Either fill one demonstration bag with some solid objects or, if you feel the group is having trouble, give each child a few solid objects so that he can directly experience the contrast.

For the next part of this activity, give each child one 10 cc syringe. Encourage the children to explore possible uses of the syringes for a few minutes. The children may discover that the syringes can be used to trap and move samples of the air. After the free activity, demonstrate the following two situations; then let the children explore each one:

(1) After pulling the plunger of the syringe out to the end of the barrel, place your finger tightly over the nozzle and try to push

the plunger in. This should help emphasize the fact that there is a sample of air in the syringe and that, until you remove your finger from the nozzle and let the air out, it is very difficult to push the plunger in.

(2) After pushing the plunger all the way in, put your finger on the nozzle and try to pull the plunger out. This is hard to do, because the pressure of the air outside the plunger tends to push it back. This is a very complicated idea for first-graders, but the important point at this time is that they experience the difficulty in pulling the plunger out.

Activity 12: EXPERIMENTING WITH AIR AND WATER

Objectives of the Learning Experiences

Investigates some of the properties of samples of air.

Observes that air must leave a space before water can fill that space.

Teaching Materials

For every two children:

2 plastic 10 cc syringes
1 piece of plastic tubing

For demonstration purposes:

2 eight-ounce jars -- one with airhole, one without
2 plastic funnels
1 piece of plastic tubing
1 plastic dish
1 plastic vial
2 plastic 30 cc syringes

Teaching Suggestions

Distribute the syringes and encourage the children to review, discuss and ask questions about their experiences in the previous activity. Allow one or two children who have particularly novel or interesting ideas to demonstrate them for the class.

Present the following three problems to the children. In each case, invite a child to assist you in demonstrating the problem to the class. Then let the children work in pairs and try the problem themselves; allow enough time so that all can experience the problem before discussing it. Discuss each problem before demonstrating the next one.

(1) Close two syringes and connect them to the tubing. The problem is to pull out one of the plungers without disconnecting the tubing. Discuss the difficulty encountered. (Do not worry if few or no children have an adequate explanation for this problem, since the main purpose of this situation is to let the children experience the problem.)

(2) Pull the plungers to the end of the barrel and connect the syringes to the tubing. The problem is to push one of the plungers in without pushing the other plunger out.

(3) Push the plungers halfway in and connect the syringes to the tubing. The problem is to predict what will happen when one plunger is pushed all the way in or pulled all the way out. In your observations and discussions, help the children to understand that the movement of

the other syringe plunger is related to the movement of air in the syringes and tubing.

After you collect the syringes and tubing, let the children gather in the demonstration area. Show them the setup of the funnel and jar without the hole in the cap. Tell the children that the problem is to fill the jar with water. Pour some water into the funnel. When it does not run into the jar, let the children discuss the problem. Accept and try out their suggestions for solving it; if they do not guess the solution, tell them that you must let the air out of the jar before the water can flow in. Do the demonstration a few times, also using the funnel and jar with the hole in the cap.

When the jar is full of water, present the problem of emptying the jar, first with and then without your finger over the hole in the cap. It is necessary to take your finger off the hole in order to let air out when filling the jar with water, or to let air in when you pour the water out.

The vial in a dish of water poses a more difficult problem. First fill the dish with water and put the vial in. Then show the children a syringe with tubing attached and ask them how one could use these to fill the vial with water. Try all their suggestions and let them decide whether the methods are successful or not. All these suggestions by the children will help you evaluate their understanding of the properties of air.

The most effective way to fill the vial with water is to use the syringe to remove the air from the vial. Push the plunger all the way in, place the tube in the vial, and then pull the plunger all the way out. Remove the tubing from the vial, push the plunger back in, and repeat the process until the vial is filled with water. Once the vial is filled, similarly present and carry out the problem of emptying the vial. On another day, set out the dishes, syringes, tubing, vials, and water to encourage interested children to independently review these problems or to invent new ones.

APPENDIX G

(1)

Training Session 3: Entry Code:

February 17, 1971; tracks 1 - 4

B = Mr. Bartlett
Numbers = Teachers

B: Ladies, if I may have your attention, I think we can probably begin. Today I would like to make sure that everyone has a partner to work with, and so I began by arranging the tables so that they had four chairs each. (laughter) And, I noticed that we had something rather interesting happen here and we now have five -- five, three, and six arrangements, plus one making a phone call. So I don't really care how many people sit at each table. It's not crucial. It is crucial, however, that you work with a partner. Now I noticed that four people signed today, but not with a partner. So I would like to know if by this time you have a partner, and if you do, who that person is. Let's begin with Sister _____.

Sister: I was Mrs. _____'s partner before.

B: Right, so you will be Sister _____'s partner. Okay, automatically. And then we have Mrs. _____ and Mrs. _____. Okay, so you two will be partners, so when we get going here you will sort of seek each other out and find a nice comfortable place to sit, and it doesn't make too much difference where it is, except that today you are going to be challenged with some rather confusing material and you'll want to have your partner close by.

(5 seconds ladies' chattering)

By the way, I was very -- I was very pleased with the response last week.

(5-second buzzer or beep)

I really think that 1984 is coming when I hear that horn. At any rate, I'd like to know how you feel about what we did last week. Anyone have any feelings about that at all?

(3-second silence)

I'm not trying to embarrass you. I am simply asking for you to select me as a target. Mrs. _____. . .

Mrs. _____: I didn't fall asleep.

Another Lady: I enjoy coming here.

B: Well, that's a good recommendation I must say for workshops, especially at this time of the day.

Sister _____: Well, uh, I thought your approach was very good and I enjoyed doing those things -- experiencing them. But I think, too, I felt a little insecure knowing that I myself am not that scientific and that I couldn't think all the time in scientific terms -- you know what I mean?

B: Right.

Sister _____: That was how I felt.

B: Okay. Anyone else feel that way? Yes?

1: I thought that the idea that was in the lesson -- making us answer questions was very good because it made me go home and look through the manual . . . (unintelligible).

B: Good. Good. Good. This is going to play havoc with the microphone here but I couldn't find a more convenient place to put it.

(10 seconds writing on blackboard)

Okay, so aside from -- let's say glowing sentiments about my qualities as a teacher, do you have any other feelings about what we did last week? About questions that might have come up, how you feel about those questions, how you might have resolved them yourself -- or any decisions that you've made.

Mrs. _____: Well, I looked up the word "object" in the dictionary. I got two definitions. The second definition I remember because it was my definition.

B: Would you like to share that definition?

Mrs. _____: The second definition was "material or thing." The first definition, I think, was "something that can be seen and touched."

1: Yes, that's what I had too.

B: Now what do you think about that, Mrs. _____. How do you feel about "objects" after last week?

Mrs. _____: Well, I guess now we're going to have to work on the properties of the objects, right? What makes it an object? You know, it's what it has in itself -- you understand what I mean?

B: Sure.

Mrs. _____: I'm trying to think of a word that would sort of cover it. What makes it its very own -- you know -- its properties?

B: Right, I understand what you mean but I'm not sure I can think of better words to express it at this point. But normally we would describe this as the attributes of the object. In other words, we decide it is an object because it has these attributes -- because it has these properties. In fact, we are actually defining the object and saying it's an object because it has properties, and if it has any property then it's an object.

1: Inborn? Inborn qualities? No?

2: Inherent? Inherent? Is inherent the basic difference? Than maybe another object?

B: Well, objects all have inherent properties. In'm not sure I like that word -- perhaps, it's a little obscure in terms of the simplicity of science, you know? I think it would come right back to what Mrs. _____ was saying last week, and that is, before you can decide what's an object you have to find an object. In other words, before you can select objects around, you have to decide what's going to fit into that bag and what isn't. Now has anyone made any decisions regarding this?

(5-second silence)

1: Well, it was interesting to me from this standpoint, that it sort of became more like a game of semantics because when you're talking with somebody you can be thinking of something as one thing and be thinking on a whole different wave-length, really. And you're actually having a discussion with the person and the two of you are thinking two entirely different things.

B: Has anyone ever experienced this sensation about talking in earnest or arguing in earnest with someone about something and then finding out an hour later that you had both been talking about a different thing altogether. I think that -- that you have certainly here one of the most important considerations that we can look at to begin with in talking about words that we use -- vocabulary we use in teaching science.

We use words like "object" and like "property" to describe something which means something rather specific in science within this area that we call science. And if I am using the word one way and you are using the word another way, and the third person is using the word a third way, well, we've got a lot of slippage going on in our field. If we all agree to use the word in a very specific way, then it's entirely possible that our communications using these words are going to be fairly clear and unambiguous, and, of course, this is one of the goals of science.

One of the goals of science is to make more sense of objects we find in our environment, in the world around us, the naturally occurring world, and the ways in which we met with these assumptions. So we really have to develop a fairly precise basic vocabulary. And in fact in many of the specialties in science, such as high-energy physics, for instance, you develop a vocabulary which is unique to that specialty alone and which would not be understood by a protein biochemist, nor should it be particularly, because he is interacting with people who only deal with that particular sub-set of the total set we call science.

Now I think that we're at a point where we can begin to say what an object is. In other words, we have a fair appreciation for the kind of slippage that can be produced by imprecise use of terms. This is one of the reasons why we begin very young with children -- at say age 5 or 6 -- we begin to promote the use of certain words in a specific way. Now this may actually offend some people. Some people, for instance, who are interested in promotion of more poetic use of language . . . I am not sure it works against that sort of usage. Excuse me just one second.

(3-second pause)

I think it's possible, for instance, to be precise in one area without feeling inhibited in your imagery -- let's say, in another area. Or even in the same area at the same time. In fact, I've seen some rather poetic responses from children who were rather good at science. Sometimes just in the realm of fantasy alone. An object? What's an object? An object is something that has properties. I don't mean to be redundant but properties are those words which describe attributes we can see, hear, taste, smell, or touch.

And so we rely on operational definitions -- really -- for properties. If we say that an object is red, then we mean that there is something about that object which when light is reflected and absorbed by the object in a certain pattern and the light which is reflected hits our retina and interacts with the color sensitive part of the retina in a specific way, it is interpreted as red inside our brain. Now this is something very concrete. We learn colors.

We're confused by colors frequently from kindergarten, first grade on. But we learn colors over a period of time. We learn to become more and more subtle. We learn scarlet, and we learn cerise, and we learn fuchsia; whereas probably at age 6, we only know red and sometimes we don't apply that too well all of the time. But we know red and we know round most of the time and if we don't know triangle or square or rectangle, we learn them in the first grade. We learn all of these shapes and these shapes also are properties that we see and they are unambiguous.

Now, in terms of the words we use applied to these properties, the words themselves may be ambiguous because the child hasn't yet perfected his use of these words. But the stimulus is not ambiguous, not unless the child, for instance, has some sort of sensory impairment which causes him to interpret red as grey, so as not to be able to distinguish red and green. But the stimulus is to the average child unambiguous and he can say that an object is red, or that it's hard, or that it's soft, or that it's rough, or that it's bumpy, or that it's wet or dry or sticky. And these are all properties. And if an object has any one of these, then it's an object by definition -- a convention. There is nothing except a property which makes an object an object. There's nothing any more innate than that property about the object which makes it an object.

1: Last week when we were talking about objects, we all seemed pretty well agreed on the fact that ice was an object and then we started having trouble when we discussed it as a liquid. But when it got to the gaseous form, there seemed to be the most dissension. And I was wondering, was the property of being invisible -- steam -- would that be a property?

B: Yes. Totally see-through. We see no boundaries to it at all. For instance, the air in the room -- except in places, for instance, where there might be dust suspended and a ray of light is passing through -- then we can see particles suspended in the air, so we can infer there's something going on there except space. There's something going on. After all, the particle is sitting up there. It has to be held up by something; otherwise, it would fall to the floor. A teeny-tiny piece of dust, it can't sit up there all by itself. It's got to have particles of air to attract it to stay up there. Some way it can get there. It might get blown up there by wind, which is itself made up of particles.

Now what we're really doing in the long run is aiming for some fairly concrete operations -- or concrete operational definitions -- of matter. But we're not telling the child this. Because in the first place, if we use a term like matter, and a child can use that term with great facility -- it's incredible -- then the child says, "Well, ______ matters," and then we say, "______ matter," and if the child is not at least, I would guess 16 years of age and exceedingly bright, he's not going to be able to go beyond this point. And even at that age it's going to be awfully tough.

It's awfully tough with most adults. But that doesn't say that because we're not able to go beyond that point -- and this is another tough one that teachers have to get over in terms of their own self-concept and their ability to teach science. And you know it's a pretty scary thing. You start teaching a subject -- or when you start seriously considering a subject -- which you may have been teaching all along. And when you start really analyzing the way you're teaching and what you're teaching, then you may begin to get concerned about your knowledge in the area.

Well, I'd like to put your mind at ease specifically about the amount of content that's involved here. The content that's involved in what we've talked about so far, and this involves about the first three weeks -- of work with this particular unit as you may have noticed in the lesson plans -- we're talking about objects and properties. The content here is all: Do you see it? Do you touch it? Can you smell it? Can you hear it? Can you taste it? Now if you're worried about handling that . . . then I'd say you have something to worry about. But if you can touch it, if you can smell it, see it, hear it, taste it, then that's all you need in terms of science. You have to practice it over and over and over again. When we switch phases of matter. What's a phase of matter?

(10 seconds writing on blackboard)

Well, for goodness sakes! Don't press me for a physicist's definition, because I can't give it to you. I'm not one. I'm a teacher. And as I've mentioned to some people already, I teach second grade, third grade, fourth grade, and sixth grade. And I deal on a fairly concrete operational level myself. I like to because the kids can understand it. And a lot of the abstract stuff that sometimes comes across in science curriculums simply is not assimilable -- understanding -- below certain grade levels and normally at that split -- we call the split between the early school and middle school -- but anyhow around age 12 or 14. And I've found that even with children at the upper limits of this range, you can get across a lot more if you're operating on a fairly concrete level than if you you're operating primarily at a fairly abstract level. In your experience you may find a little validity in that comment.

Well, what are phases of matter? Phases of matter. Very simply you understand, three basic phases of matter are these categories that we call gases, liquids, and solids. And this basically has to do with a couple of things, whether or not an object is a solid, liquid, or a gas -- but whether or not it's a solid, liquid, or gas, as water, for instance.

And when we talk about water as ice, or water as water in a stream or water when it has evaporated, what we're really talking about here is the arrangement of the particles in that material, the arrangement of the particles, the alignment of the particles since particles have directions. A water molecule, for instance, always has a shape that's roughly like this. The two hydrogens and the oxygen occur in this relationship to one another. The bond angle stays. This is an attribute of the molecule itself. In ice, certain things happen to the arrangement of the packing of these molecules. In water, the arrangement of the particles is a little more loose. They can move more easily because of the difference in temperature. Generally speaking -- generally speaking, again to be very loose, as the temperature decreases, the amount of movement between the particles decreases; and as the temperature increases, the amount of movement between particles of matter increases. Also generally speaking, the distances between particles increase as temperature increases; and the distances between particles decrease as the temperature decreases. This doesn't always occur. We know it happens when water freezes.

Have you ever tried putting water in a jar and filling it to the top and then screwing on the lid and then putting it out on the doorstep? Here, we have an anomaly. We have something which we don't expect happening -- according to that particular model. Okay, so gases: Particles are fairly well spread out and they're all hopping around pretty much, but in order to explain this in a more adequate fashion, we have to go into some pretty fancy physical chemistry and I don't think there's any particular reason to do that. In liquids the particles are closer together and they don't hop around as much. In other words, there's not as much energy involved here in the movement of these particles. In solids the particles are even closer; yet closer together and they don't move around terribly much, but they're still moving. And you know we can talk very abstractly about movement of particles. In this table the carbohydrates that go -- starches that go -- to make up the wood here -- the cellulose, for instance, which is nothing but a fancy sugar. It's a great big ol' long drawn-out sugar particles -- are sitting there but they're all moving still. They're all moving.

There's a certain amount of inherent movement in all matter, but fortunately it doesn't move too much. It stays pretty much right there and we don't have to worry about it and when we come back tomorrow, it will still be there because it's a solid -- because the relative movement is fairly small. Well, I think I've confused you enough with this. At any rate, the fact that an object changes phase, in other words, its particles become more distant or more close and they have more or less energy associated with their movement has nothing to do with their being composed of matter. The matter is still there. It's just distributed differently. And in fact, if you think about the world or the universe or our neighborhood or any other nice, neat unit which we really can't functionally separate from the rest of everything, there is a certain amount of matter there and there's a certain amount of non-matter there. What would be a non-object that exists in our room here?

(3-second silence)

1: Maybe something that we might see that might be pretty, something abstract. Beautiful?

B: Okay, any other non-objects?

2: Thoughts . . .

B: Okay. Any other non-objects?

3: How about voice?

B: Well, what are the criteria for voice?

3: The properties might be four senses, no hearing. It would be -- one of the properties would be hearing -- so that would make it . . .

B: Well, if you can perceive it then . . . when we talk about voice, we're really talking about something a little different than sound. We're thinking of a specialized form of sound -- sound which is generated in a specific way, but it's still sound. It's a, you know, it's just like sound as a heading and then A, B, C,; guitar; voice; record player, and so on. It's still sound. We can hear it, so therefore . . . That's a toughie because in a way, it is and in a way it isn't. Actually sound is . . . Miss Green? I've worked myself into a hole. Sound is actually a . . .

1: Well, it's -- one of our senses, which is hearing.

B: If you can hear it?

1: It has to be an object.

B: Has to be -- has to be. Now it's a special kind of object. Let's put it that way, because sound is really -- comprises the bouncing of particles in the air against one another.

1: Then again you would have to be there to listen to it.

B: Right, or it isn't sound. I'm not sure. I don't want to get into that argument. That's a tough one. But at any rate, by our definitions, sound would have to be an object.

2: Then you're working in terms of what's operational for you. On that basis you would have to accept it as an object.

B: Right. Now all of a sudden I begin thinking: Oh, oh, we're getting the interaction here between particles in the air, and the inner ear, vocal cords, and the movement of the larynx and all of this stuff, and according to the concept in my head, sound is not an object. It is an interaction effect between all of these other objects -- you see what I mean? It's an attribute of the interaction of vocal cords, larynx, molecules in the air and so on. And according to our definition, it's not ambiguous because we have specified if you can hear it, it's an object. Okay?

Now we might say here by way of interpreting -- this is something you are going to have to face with your kids because sooner or later, they're going to hit you with this. In fact, they're going to hit you with it sooner probably than you would hope that they will. The thing is that the child will say to you: "No, the larynx, or the structure that's making this sound, I can feel it vibrate and that's the object. It's doing this and the sound is just what goes between the object and when you hear it." Now what would you say to that?

1: Well, I was going to say that sounds always . . . (inaudible).

B: But are you going to do that in the classroom?

1: But wouldn't the child perceive sound . . . definition of an object?

B: Ah, ha! Would he or wouldn't he -- this is the big question.

2: But before you would get to that, you would already have set up the attributes. Right?

B: You would have set up the operations here -- the proofs: If you can hear it, then it's an object. If you can see it, then it's an object. But you're not going to always get agreement. And I think that you have to be ready to face this kind of problem when it arises. And it's pretty important at this point to not say to the child: "Well, I said. This is our rule."

2: That's right. Would it matter that if two do not agree that it's a sound?

B: Not a bit to me.

2: I mean in general?

B: You can say to them: "Well, what was the basis for the decision that you've made?" Let the class look at this and see if this is a valid point of view. Are they using evidence properly? Are they inferring the status of object or non-object properly according to the rules? And if they are, then they're right. If they don't agree with you, fine. Because in the first place, one of the things we don't want to do, and which we do, of course, continuously is to produce, you know, a bunch of kids you are tshung, tshung, tshunging all exactly the same; and all have exactly the same ideas. Now it works; it really works because we have the power.

We have the power to do it, we have all the rewards, we have all the punishments -- and I use that term very loosely. The child is a very sensitive device, and he knows when you agree or disagree with what he's said. He knows by the way you ask him "why?" what you don't agree with him and he'd better think up something else fast. And if you think about it, if you sort of relax when you're asking the question, if you sort of relax when you're thinking about the question you're asking the child, you may -- just do one thing -- watch his eyes. He is watching your eyes every second to get some kind of feedback: "Is this right, teacher? Is this right? Is this any closer to it?" It becomes an eye-contact guessing game. Is that what we want? Is that what we're looking for? Yes?

2: According to this definition that we've set up, would a dream be an object?

B: Not to me, it wouldn't.

1: Would you think it would be, Mrs. _____?

2: I don't know.

(20 seconds airplane)

B: Well, this is one of the very good ways of collecting evidence, and let's say establishing proof of the status of an object. The observation has to be, what do you call? Replicable -- something like that -- I don't know if that's a word or not.

(5-second pause)

A dream, as I understand it, is basically an interaction between certain circuits in the brain. When the brain is fairly much at rest, these subcircuits are operating and are swapping and combining information of various sorts. And it's not at the level of what do you call it -- consciousness. It's operating below the level of consciousness. So a dream is not really in this sense, using the senses at all . . .. It's using stored information which has come from the senses but is using really interpretations, which is the brain's job. The brain has the primary job of making interpretations. It tells you what this electrical impulse that comes in from a specific place means and, of course, we've found that out by doing experiments and switching currents attached to the brain and it's possible to interpret visual input as a sense of color or touch. It's possible to switch these circuits and these are pretty much learned -- well, most of them are learned -- the interpretations. In other words, red is learned. The child isn't born with red. He's born with the sensory ability to perceive red; he's not born with the concept red. That's something we do. In fact, we can do it fairly well before the child goes to school. Most of his basic colors, letters, . . .

3: Excuse me, When you speak of object, the opposite would be non-object or thing?

B: Well, I think you could call either one conveniently. Now the problem about using thing is that thing is a fairly common word in our everyday life. Here is where we have to specify what we're talking about. Is it science or are we talking about everyday life? The child typically likes to make everything very simple so you know it's either this way or it's that way. And I think it's very important for the child to develop an appreciation for the differentness of science. In other words, . . .

3: What would be the opposite of object then? Just non-object or thing?

B: I would say . . .

4: Put your things away.

3: But if that's the opposite . . .

B: Well, I don't know what I would say, but if I were a mother, I hope I would say, "Put your objects away."

5: Oh, come on!

(laughter)

6: Well, it doesn't matter. It's very difficult to tell a first grader we're using two languages. We're using a science language one week . . .

B: No, it's not difficult at all. In fact, a first grader is very impressed by saying: "Okay, now if you're going to be a proper scientist, you're going to have to use the kinds of words a scientist uses."

6: I agree, but you can't use the same. It's hard to use the same word to mean two different things. All right. Give them another word; give them non-objects, but not thing because . . .

B: Okay. As long as they understand that "thing" and "non-object" are the same.

6: Why should you tell them they're the same?

B: Why not? Because otherwise they're going to use "thing" in place of "object" at the wrong time.

7: As I do.

B: As I do, too. I've been doing this for a long time. I still slip.

6: You mean that "thing" is a non-object?

B: A thing is a non-object. All things are non-objects.

6: I thought I read in the teacher's guide that it said: The word thing, which can be used to refer to abstractions, has too broad a meaning to be useful in a science program which tries to communicate the concept.

B: Right. Well, what this is really telling you is that things in everyday usage are used to be both things and objects, and this simply is not -- does not have enough utility for scientific vocabulary. We somehow have to distinguish between objects and non-objects. Therefore, we split the everyday-thing category. We say, "chung" -- all of these are objects which have properties and all of these over here are things or non-objects because they have no properties. Now you'll get into some terrific arguments within a class about whether or not a thing is an object, because they will say, well, for instance: "In the second grade a child told me, 'Well, love is an object. You feel it.'"

7: Is it important enough to make a fuss ? . . .

1: Well, can he feel it with the sense of touch? It's an emotional kind of feeling.

B: You have something to say, Miss _____?

6: I said, is it important enough now to teach objects and non-objects -- to get into the semantic problem of things, meaning two different materials?

B: It's very important to distinguish. It's very important to talk about. I think -- extremely important to talk about.

6: (comment which isn't intelligible)

B: I'm talking about when you're a child. I'm not talking about here. I'm saying that I think it's very important to discuss multiple meanings of the same word. We would do the same thing with words which are not quite so disturbing for us, you know, in their context. We teach multiple meanings to other words in our English vocabulary. What's another word?

2: Thought?

B: No, another word which has many meanings.

3: Train. Train a dog.

B: Train, right. Train the dog, right. Okay.

3: But since teaching science to the first grader, we're going to have to pioneer "object" -- this is the main idea of the first couple of lessons -- to get them to establish their own operational definitions for "object." Wouldn't it be more profitable -- let's say, in guiding the class in guiding the group -- to try to get them to this point -- to start with the word "non-object"? Then when the word "thing" might develop out of their everyday usage, then to make the distinction there, wouldn't it be easier for them to comprehend if we did use in our own discussion the word "non-object"?

B: You're a very quiet group.

(5-second silence -- 3-second comment, unintelligible)

3: In the first grade the child would think a thing was an object.

B: I agree.

2: I mean we're not after the English teacher as much as we are the scientific concept of object and non-object and it would be easier for us to get at this if we talked about this as object and non-object.

B: Well, it sounds like a very sensible idea to me. Rather than confusing them, for instance, in the beginning -- but now on the other hand, for instance, I would start off simply using the word "object" and I wouldn't tell them what object is. I would spend several weeks with the child just talking about objects. For instance, just start changing your own vocabulary. Just start saying, "Well, Jimmie, would you go and get me the brown -- tall, orange-and-brown object which has a handle on it -- it's over on the table against the wall." And it can get to be, you know . . . That's perhaps a little extreme, but instead of saying, "Well, go and get me the cup," because "cup" is a rather specialized concept. There are many objects that can have pretty much the same sort of properties and will not be a cup at all. We would even consider using as a cup, okay? What is this object?

3: A chair.

B: What is concept "chair"?

4: Are you talking about the function. What it's used for?

3: To sit in.

4: What the function is? What it's used for? You can sit on it. You can stand on it.

B: Uh, pardon me one second (30 seconds). Looks as though I'm not going to succeed. . . . Now what would happen, for instance, if I took this object out of here and put it into this object. What would this object be then?

3: A cup.

4: It would be a planter.

3: No, it would still be a cup. It's just function that you're talking about.

B: Right. But the cup itself is a function you see. The cup itself is a function. Concept cup.

5: That's right.

B: Refers only to function . . .

3: Couldn't it contain something else?

B: To what function? What is a cup?

4: It's something you hold.

B: Really. Oh!

4; That's a cup (referring to a bucket).

(laughter, then 15-second silence)

1: It would still be a cup if you put (5 seconds). When you stood on the chair, it was still a chair. You weren't there standing on a stool.

3: You could sit on a stool.

1: Sure, you can sit on this.

B: You're not going to change my mind. It's still a bucket.

1: Right. It is still a bucket.

B: Okay. What effect would there be if I took some pretty tinfoil and put it on the outside?

1: But it's still a bucket.

2: Then, you might be changing it because you have disguised its look, but a bed is still a bed. If I stand on it, it's not a chair; if I sit on it, it's not a platform; if I stand on it, it's still a bed. . . . However, if I get a different kind of spread, I can make it -- by trying to change the bolsters -- I can make it look like a chair. They may have overlapping functions, but they still have a name which we have given to them. That's the reason we call a cup a cup, a chair a chair, a table a table.

B: What is it that is significant about that gray metal object that's sitting on this table?

2: The general use of it.

(5-second pause)

B: Is it significant that this object is a bucket?

(3-second pause)

B: If you need a bucket, is it significant that this object is called a bucket? What is significant? What is significant about this object, if you need a bucket?

T: It will hold a lot of water.

T: Its function. As a container . . .

B: You already told me its function. You said it was a bucket.

T: That's not its function.

B: What is its function? Only a bucket, right? Is that the important thing about it? What _is_ important about this object?

Sister: You can see it. You can touch it . . .

B: Oh! You're getting very philosophical, Sister.

3: What are its properties?

B: Well, what _are_ its properties? What do you mean by that?

4: It's hard and it can contain something.

B: Okay.

5: Something concrete that's there -- something you could, you know, touch.

B: Well, that's true. What is it about the object that allows you to haul objects from one location to another?

6: Because this one has a handle.

B: Okay, so then it's easier to carry. What else about the object? Several people have mentioned it, but I'm just trying to bring the focus on it.

7: It's deep.

B: Okay. It's deep in relation to what?

(10-second silence)

8: To the cup . . .

B: Yah, in relation to a cup. Well, it's deep. So this sort of comparison we're making here -- property deep is a comparison to the property. When we think of deep, we think of another object which isn't deep. It's part of concept deep and concept shallow. And what's shallow and what's deep make a difference in terms of the objects that you have been exposed to. So now what's shallow and what's deep can vary quite a lot within this room if I asked everyone: "Okay, take a piece of paper and write down the depth of a deep object; write down the depth of a shallow object." What are we going to come up with?

(3-second airplane)

Who knows? We don't have to. We know the answers will vary probably as much as the number of people in this room, that is, if we don't allow any collaboration -- the answer.

At any rate, what I'm trying to bring to your attention is: Calling this object "bucket" is most of the time quite useless because concept bucket is a fairly well-known broadly experienced concept, okay? The fact that this object is a bucket isn't what makes it unique. There are certain properties about the bucket which cause it to be usable as a bucket, and which also allows it to be used for other purposes. You can use it as a container for storage. Now in the garage where I park my car, they have these hanging from hooks, and they're painted red and they're full of sand. The Fire Department makes sure they're there for oil fires. It's not used for exactly the same thing. You could fill it with dirt and plant flowers in it, punch holes in the bottom so that the water can drain through, or if we lived on a farm, and we had a cow, we would milk the cow, and use it to carry the milk in.

Well, we've used up a lot of time in talking about objects and I'm going to give you a little bit of fun. What I want you to do is this with your partner: We have some unknown, at present, unknown powders, and I'm going to put out containers of these powders labeled 1, 2, 3, 4, 5 on the table. And I'm going to give you some powders which are not numbered and I'm going to ask you to determine what is in the envelope I give you. Okay, now . . .

(writing on blackboard -- 5 seconds)

And I'll put them out: 1, 2, 3, 4, 5. And I'll put them over here near Miss Green and put them in a row and you can come up and take a little bit of each one and test it out any way you like. And . . .

1: Will we die if we taste?

B: You can taste these objects; however, I would suggest that perhaps tasting is one of the less preferred techniques for getting information. There are two reasons for this. Number one, we try to discourage tasting as a standard way of getting information among young children. Number one, they're all too willing to do it. Okay? And they are too willing to taste an object which is -- they don't know is safe. They're willing to taste practically anything, and so, what I would suggest is that it might be a rather dangerous concept for us to be putting across -- that taste is a good way of getting information. In fact, in science, and this is true, and we can use this with the kids too, you can say, "Well, the scientist would never taste anything unless he knew that it was safe to taste -- unless he was absolutely sure." And so if you're to follow this rule that scientists themselves follow

(5-second buzzer)

then you would not taste any of these. I am telling you that they're safe, they may not taste very good, but they're safe. And in fact, we will never introduce any material in the classroom which would not be safe, not at the first-grade level. Later on, we might, because we expect the children to be perhaps a little better trained, a little more cautious and so on. It's not quite so difficult in terms of when the teacher isn't looking -- they take a taste anyway -- which, of course, we can expect them to do that. So good safe materials . . .

I would like you to come up. I am going to put all the materials that you will need to test -- some of these materials -- right up here. Here are four objects that you may get. You will do this by pairs. Here are some plastic medicine cups which you may use to get samples. There are sticks which you may use to collect things -- to collect bits of these mixtures. Miss Green, would you . . .

Miss Green: Yes, but make sure that what you take, you know which number it is.

1: Are they in order?

B: They're in order, but be sure you remember . . .

Miss Green: And they're in order 1-5 right here, and I'll put the covers on the bottom.

B: The covers will be behind the containers so you can tell the numbering. Now we have here some interesting objects. Containers, squeeze bottles, and I think there's probably one for each table we can share. These have a diluted solution of iodine in them. The dropper bottles, the squeeze bottles . . .

2: Iodine?

B: Iodine. Okay. One of those can go to each table. We have also some sticks which you can use to collect samples and I suggest that we also have some vinegar which you may collect in a medicine cup, which you may use also to interact with some of the powders if you like. I would get a container of water and bring it in, and in a moment you may try that. You may try -- oh, paper plates. That's an idea. But they can test their samples in these medicine cups.

Number one, we have five powders here, okay? These are not mixtures. You will want to observe these powders, find out what they're like. In a moment I will come around and distribute three powders to you which are not known -- in a little envelope.

(15 seconds writing on board)

Okay, now, you have to tell me which of these are in these.

(10-second pause)

Now would you like to come up -- try some of these. Please send only one member at the beginning. When she goes back, then the other one can come up and get some objects, perhaps.

(10-second pause)

Please do not use the wooden sticks in any more than one container; otherwise, we may contaminate the pure materials, okay? In fact, we might stick a wooden stick in each container, and in that way, we won't have to worry about it. And you may also take several back to your seats with you and just leave the one in the container.

(15-second mumbling)

1: I want to taste them right away. I'm just like a first grader.

2: It's good to get into the habit of . . .

B: Okay, here's some water, if anyone needs water. Now I hate to be so directive, but I would suggest that what you are looking for here is anything, any property of the particular material which is characteristic of that material.

(10-second pause)

No, you have to tell how you can tell them apart first. How can you tell them apart? Are they the same? Are they different in terms of their properties?

3: These two look very much alike and I know they're different, so what could . . .

B: But there must be something different about them in the . . . Maybe they are the same; maybe I'm fooling you.

(10-second pause)

Okay, here come the unknowns. This is unknown one . . .

(50-second pause)

Now when you have decided on properties, be sure and write them down somewhere. When you've decided what's in unknown one, then raise your hand and I'll give you unknown two.

(End of Side 1)

(Side 2 has about 300 feet of mumbling, which is, indeed, the ladies' doing their experiments. It is, however, indecipherable.)

APPENDIX G

(2)

Training Session 5: Entry Code:

February 24, 1970; tracks 1 - 4

B = Mr. Bartlett
Numbers = Teachers

B: No rush. Be sure to sign. First things first. Be sure to take an index card. If you will, give me this information that I have on the board, please. On the index card . . . If we can do that before we get started, it will save a lot of time.

1: Listen, you'll have to tell us now how many lessons you want us to plan for the week -- all those things today -- because otherwise we wouldn't know if you want -- you know . . .

B: Well, you can ask when we get to the general session.

1: But we've been wondering about that -- you know whether we should have two on one activity or just as much time as we need on one activity?

(approximately 9 1/2 minutes of gossiping, etc.)

B: How many people do we have here as it stands? Let's see. Are we missing anyone? We're missing one person. Whose partner is not here? Whose partner is not here? Two, four, six, eight, ten, twelve, sixteen, eighteen, nineteen . . . Someone's partner isn't here?

1: It's a woman that's alone usually, uh . . .

B: She has to have a partner.

1: No, I've seen her alone.

B: Everybody works with a partner. Do you have a partner? Good. We'd better wait just a couple of minutes for her, and then I would like to talk about these items.

Miss Green: Well, while we're waiting, Mr. Bartlett, may I introduce Mr. Ratner.

B: Please do.

Miss Green: If I may have your attention for a minute, some of you may have met Mr. Joseph Ratner, and others of you may not. Mr. Ratner is the principal and coordinator of the teacher training program in District 29. He is responsible for getting the in-service courses listed here initiated and off the ground and anything that has to do with teacher-training. He may have been in your school. If not, he will be there sometime or another. But I felt that you should meet him, and he should, at least, get to know you since this is a special first-grade teacher-training project in the district.

Mr. Ratner: Thank you very much. Now I asked Miss Green not to call upon me this week because I have come as a trainee rather than a trainer. I wanted to stop and say hello, and I am delighted because of three things: One, as you see, I have a cup of coffee and a couple of cookies; and secondly, if I hand my name in, I notice I immediately get a check; and thirdly, it's so nice to see that there are representatives here from other than the public schools and I want to tell all of you -- and that especially how very welcome they are and how much we enjoy them.

Miss Green: Thank you very much, Mr. Ratner, and please stay with us for a while, or . . . whichever you choose.

B: I do see a few people haven't signed today. Please do so if you have not. The sign-up sheet is up here. Take an index card and provide the information that's on the board (10 seconds). Your partner is over here, I believe, so let's get you a chair (10 seconds).

Okay, now if everyone will listen for just a moment. Let me explain this business on the board. It's very simple. If -- I'd like you to provide three items. First, your name and the address to which you would like to have your stipend check mailed, if that is other than honorarium -- if that is other than your school. Now I know that some people prefer to receive personal mail at home and so on, so if you want to receive it at a different address than your school address, put that down. If you want it sent to your school, you can just say school, and you don't have to write it out.

The next thing is: Please give me the number of children in your class. This is particularly critical in the case of the non-public schools because the class numbers fluctuate there so much and we might have to provide extra materials for these classes. Now in the public schools, I don't know how much variation there is, but it would be good for me to know approximately how many children you have in your class.

2: Also, when you take into consideration -- take into consideration one or two more because it would be frustrating . . .

B: Always. Right? Our materials are basically provided for groups of two or groups of four within a class, anyhow. There's quite a lot of flexibility. But I will try to provide you in most cases with materials for at least 30 people and I think that should hit most of the public schools reasonably well.

3: We have 33.

B: Oh, well. In that case, it's good that I know that because I'll have to provide extras. Now, on observation time, there's a little bit of confusion. Let me just tell you what I want on this. We have three people who are going to do all of the observing. As I mentioned at the beginning of the program, these people are all experienced supervisors; they are all retired New York City supervisory personnel, principals -- ex-principals, ex-supervisors, subject supervisors, and so on, who are from St. Johns University and on the staff there. They will be providing a certain amount of time for us in between their other obligations -- their obligations to the University and so they have certain time limitations.

I realize that you also have certain time limitations because certain times of the day your children may be going to recreational activities or they may be doing something where they could not -- they would not be available for a science lesson. Please tell me three things: The time that you would prefer the observer to come. In other words, if you prefer morning, prefer afternoon, prefer a specific day of the week -- tell us that. And if we can do that, I would like to do that. In other words, I'm going to hit for the preferred time. Secondly, tell us the times when we cannot come at all. In other words, the class won't be there, or you will not be receptive to the observer, or whatever reason it is. I mean that's up to you. If you have a meeting, or a cluster meeting, or a grade-level meeting, or something like that, please tell us those times when you will not be available. Now we realize that in certain schools -- in public schools -- there will be in the first week of March, meetings in the morning until 10 o'clock, and so we understand that already in certain of the public schools. Yes?

1: When will the observations start?

B: They will start next week.

1: Oh, and you told us we wouldn't start any of this until after the three lessons.

B: No, after this three meetings.

1: You're not to start it beforehand.

B: Right. In other words, you're not to start teaching until next week, when the observer will come. Okay?

1: Then you want us to teach our first lesson for the observer?

Miss Green: Yes, may I add that the observer is not coming to evaluate you as a teacher. This is very important. (laughter)

This you must . . . I hope you realize this. He's not coming to evaluate your performance the way a principal would walk in and evaluate your performance.

3: Why's he going around?

B: We cannot unfortunately tell you.

Miss Green: I think for the purpose of Mr. Bartlett's study, it would not make his study valid if you knew what the observer was looking for. And this is extremely important. You'll see the reason why when he sends you the final report. And each of you will see the final report on the study. But I can assure you and -- please take my word, I guarantee you, that your performance as a teacher is not being evaluated, not in the sense that a principal would come in for a formal observation.

4: It has to be good for results though.

Miss Green: I'm not saying that. There are certain things that the observers have been trained to look for that we cannot tell you now because of the purpose of his study. After all, if you knew what he was trying to prove, what his hypothesis was, you'd throw the whole thing off by helping him to succeed.

5: Would you prefer that we taught our very first lesson in science for the observer?

B: Let me explain. We're talking about two things. In the first place, I was trying to clarify the schedule. Finish that one before we get on to the next one. Please let me know when you cannot be observed at all, because that's very important. Try to leave as much time as you can open so that we will have a little bit of freedom in setting up the schedule for the observer. In other words, there're only three observers, and we have to schedule their time in blocks of ten schools, because we have 30 schools. We're putting them together in clusters so that it will make it possible for them to get around to the schools. So if you can leave time open, please say "mornings" or "afternoons" and just leave it like that -- if you can. But let us know times when we cannot come and let us know the times you prefer. Okay, now going back to the whole other thing about the observation itself. As Miss Green said, this is not an evaluative observation. Our observers are looking for certain specific things which I cannot relate to you. If I did the whole thing would be out of order.

Miss Green: But we all want him to get his doctoral degree, right? But we won't help him if we prove that before he can start, we're making him successful.

B: Now, the problem is: I know that with a new program, you are concerned and you're concerned about your own expertise as a teacher. Please do not think about us -- in other words, myself or my observers as coming in to judge or evaluate your expertise as a teacher in any way, because we're not doing this. I can tell you that much. That is not the point. I can tell you that that is not what we're looking for. But I can't tell you what we are looking for.

I can also tell you, by the way, that the observer reports come to me, personally, and to no one else, if that will help conceptually. They will not go to your school, they will not go to the district except as my evaluation comes out in the form of statistics at the other end, which, of course, you're not identified as an individual in any way in the statistic, okay? So, I hope that that is relatively clear. Now, you may begin teaching on Monday in any way that you like and at any time that you like, and any amount of time that you like. Now it's going to be a heck of a problem setting up the observer schedule and I'm going to have to have that done within the next few days. I already have the Wednesday-group people's cards. With yours, I'll be able to set up the observer schedule for all the observers, and I'll probably end up having to call your school prior to Monday sometime, giving the first day. I will send you a note with the whole four-week schedule saying where we'll be at this time, once a week for four weeks, and that's it. Okay? Does that make sense? I don't know if it is . . . I'm getting all confused now. I've been talking so long.

1: There's one little question in my mind. It makes sense what you're saying, Sir. This I want to know: Do you think that we will know on each of the four weeks -- the time that the observer is coming so that we can have the work set up in time.

B: The specific time.

Miss Green: Mr. Bartlett will call your school prior to the first visit by the observer to let you know which day and what time, and that will be followed by a schedule which will list all four days and the times.

2: Will it be the same day?

B: Same day, same time. This will not vary. This will not vary. In other words, in order to simplify it for our observers we need to do this because, of course, they have other obligations also. They have people that they're working with in other schools. And, of course, they have other obligations. Any other questions on this?

3: You know the first grades are having conferences?

B: Yes, we know that.

Miss Green: So if you make a note that your -- not all schools, some schools -- one or two schools will not have them. But if your school has them, just make that note.

4: Does it matter what lesson the observer observes?

B: Um, no.

T: Wherever we're at?

B: Right.

T: There are twelve lessons . . .

B: They're not looking for anything specific in terms of lessons.

5: There are twelve lessons.

B: Right.

5: What would be the ideal objective -- at what time -- how long -- how many weeks would be the ideal objective to complete these twelve lessons.

B: I'll give you my estimate, and it probably won't work for anyone in the room. But my estimate is that if you pace the material even fairly rapidly, it would take you six weeks to complete the unit. If you dragged it out, which is what I do frankly; with a lot of practice, then it might take you several months.

6: Would you say six weeks, Mr. Bartlett? How much time each day?

B: I'm estimating there anywhere between an hour and two hours per week -- totally.

7: But that would be two lessons. If there are twelve lessons, in six weeks it would be two lessons a week.

B: Yah, a lesson is not a lesson in terms of the lesson plan. In other words, one of these lesson plans may last you for three or four days.

8: Oh, that's what I mean. Now we can embellish, or change, or create, or not create or leave out.

B: That's your prerogative as a teacher.

8: This is your general outline, because I, you know, as a lesson plan, this is a couple of things that I would -- doing it, I would feel that I couldn't, but I can . . .

B: Absolutely.

8: Can we do the same lesson twice?

B: Sure.

9: These lesson plans are really guidelines, aren't they?

B: They're guidelines and they're really a way of giving you a few ideas about how to begin to approach the lesson, what to do, what to look for, what materials to use, okay?

1: Yeah, so we stick to the general outline?

B: There are not prescriptions here. And you don't have to stick to lesson one, lesson two. And if you find that it's a little slow going to begin with -- well, take your time. There's no rush.

2: When we complete the lessons, the twelve lessons, if it takes six weeks on . . . Is there any evaluation that you have, or you want other than the visits?

B: Yes, at the . . . It is anticipated right now that we will ask someone to come in, either the last week or the week after that. This is not totally sure right now.

3: What is it? Of the term?

B: No, of the -- after the four weeks of observation. In other words, either the fourth week or the fifth week -- we would like and at the point right now it's sort of hazy -- to have a person come in to talk with the children. In other words, it will be sort of an interview technique of testing.

4: That's when you've completed, or just . . .

B: Whatever you've done.

4: Wherever you are?

B: Wherever you are. It has nothing to do with what you're doing. We would just like to see how the children are using words, and so on.

Miss Green: I would like to add something to that if I may at this point, Mr. Bartlett. About the second week after the vacation, I know you were told that you would have only these three sessions, but I would like to put it on a volunteer basis, and ask you to come back, those who would like to come back, and I think you might find it interesting and valuable to discuss yourselves what has happened in that period of time -- sort of tie things up together and I'd like to take that time to show you then what to do with the materials with your own particular program for the rest of the year and for the following year. So I'm going to leave that on a voluntary basis.

1: When will that be?

2: You will contact us?

Miss Green: I will send you a card. And it will probably be the second week that we come back after Easter Vacation. It would be a Tuesday again, but it would be the second week after the Spring Vacation.

2: Would this be when you're finished?

Miss Green: Yes, this program would be finished. And I just thought that you might like to have an exchange of your reactions and what took place and sort of tying up things. And then, perhaps seeing, not seeing, but I would like to give you guidelines on how to use the materials that are left in the school, not only with your own classes, but with other classes on the grade, and how they are related to the city course of study and the state course of study. And as I have said before I had hoped that perhaps this might be -- you people might be the very -- what shall I say -- the innovators, to start what we might call sort of a community clearinghouse where -- now that we have had this opportunity to meet with private and parochial schools in the community, we can not only exchange ideas, but we may even help each other with the exchange of materials or equipment and find out what's going on. And, I guess, realize above everything else that we're not alone in our problems. We all have the same or similar problems. But I'm going to put that thing on a volunteer basis because you were originally asked to commit yourself for three sessions. I'm asking you to, for those who are interested -- to come back for one more and I will send you a card. It will probably be the second week after the Easter Vacation. All right?

B: Um, I think we've taken care of the bookkeeping chores. Question? Yes?

1: The materials -- when will we get them?

B: I would hope that the materials would be mostly distributed on Friday morning. Now the materials are not yet all together and we're working franctically to get them together. I have people working nights on doing it. I've been working afternoons myself. Students at the school have been helping. I had to go to New Jersey to pick up some materials yesterday so it's just on a day-by-day basis right now. We don't know when they're going to be ready, but I'm hoping for Friday-morning distribution. Right now it's a little hazy and if it runs over, it might be Monday morning. But it will be either Friday morning or Monday morning that they will be distributed.

Now the materials are essentially as they're listed in your book and I don't think there could be any problems. You may find that the quantities vary slightly. Let me tell you about several memorable exceptions to the book. One is where magnifiers are called for -- there are several activities in which magnifiers are called for -- one per child. Unfortunately due to our budget we are only able to provide one per two children. And since they cost us about 60¢ each, it ran to about 3/4 of our equipment budget just for magnifiers alone. So that item has been changed. Another item which has been changed are the mortars and pestles. Another item which we had hoped to provide -- as I recall -- one for every two or one for every four children. These will be provided two per class -- two per class, and they will have to be rotated as children are using the mortar and pestle. Unfortunately, due to cost again. These ran about $450.00 just for mortars and pestles.

1: How many were we supposed to have per class before?

B: About one for every four children as I recall. The ideal, that would be it. They're very heavy, they're very expensive, and I think that you'll be able to get along with two. However, it might be tough.

1: Improvise?

B: Oh, yes. Right. As far as the crushing activities are concerned. Or borrowing, if the science -- has . . . Right.

Miss Green: The mortar and pestles you don't have really in the elementary science program, but there are schools that have -- I know of our own schools -- many of you have magnifying glasses. Now if you can possibly take the magnifying glasses out of the science closet and use them for this particular program, I'm sure that would be all right. For those of you whose schools I haven't gone to yet -- I will be there -- I will speak to the principal about that. Perhaps I can even get out a notice to the principals of these schools that -- where he can help out in the program -- to allow you to have equipment for that period of time.

(buzzer 5 seconds)

B: Well, I think that takes care of housekeeping chores. Would you pass up your cards please; pass them along here so they . . .

1: I don't have anything written for "C."

B: That should be empty. "C" should be empty. Right. Actually, in other words, all the open time -- the time that we could schedule if we need to.

2: But don't you want to know what?

B: No, just leave it open, In other words, you're there from what? Nine to three, and that you take lunch out in the middle. Now if you have times that you want us to come, times you don't want us to come -- well, tell us that; and all the rest is open time. Okay?

(mumbled questions -- 40 seconds)

Miss Green: I'll be there Thursday, and I'll see Mrs. _____. Is there anyone else here who would have a conflict with being on duty, either lunch duty or yard duty or whatever . . .

3: They won't come during lunch time?

Miss Green: No, but some people have lunch at different times. There are double or triple sessions. All right, but that's the only one with the problem. all right. Well, I will be there . . .

(1 minute, 40 seconds unintelligible)

B: If you have an unusual lunch hour -- a lunch hour at a very strange time -- you probably should . . .

(30 seconds unintelligible)

Actually this question has come up. Would it be all right to start tomorrow? I see no reason why not; of course, you won't have materials. But there are a lot of lessons that you can actually do without the materials, and if you want to do that, go ahead. Because I don't think that would interact with our training . . .

Okay, well, let's throw the whole business open now for any kind of questions or problems -- conceptual problems -- that might sort of be in the air right now about teaching this unit.

1: I have a question about the discussion that we had on sound and the feeling that sound was an object. Because it seemed that we were basing it on the premise that an object was matter, and sound would not fall into that category just because it's something that we could hear. The same as heat or light. And if you were to classify sound as an object then you'd have to broaden the meaning of an object, and be able to include heat and light.

B: I was thinking about that just now, as you were sort of describing the sound (signal). I think where we get into the bind is: which end of the sound are you considering? Are you considering where it begins or are you considering where it ends? In other words, are you considering sound to be something which exists at the ear drum, or are you considering sound to be something that exists, let us say, in the object that produces it. I think that's a pretty tough problem -- deciding about this.

Now sound to me, as I just throw it out, is not an object. Sound is a property of an object. Sound is a property of an object. These cards make a certain noise when they're banged on the table. This is the property of the card and the table. When you bang the card on some other object, then it's a different sound. Now we can use the difference here to tell what kind of an object the card is being knocked against. There's a difference. This will help us to identify the objects which are interacting at that particular time -- the difference is sound. So, I'm not sure that I can go any further than that. Philosophically, I think that you have a tough problem there. I'm not too hot on philosophy, but I think philosophically, you have a tough problem.

2: It would certainly not be matter.

B: No.

2: (unintelligible, 4 seconds)

B: Right. But on the other hand, the child wouldn't be able to make this distinction. I have never seen this problem come up with children. I have heard them use sounds, different sounds as properties. Now when you drop a plastic spoon on the floor, it makes a sound which is different than when you drop a rock. And this helps us to tell which object has been dropped when the child closes his eyes, and you say: What evidence do you have for the material of which the object is made?

3: I think once you establish the definition of object to your children . . . The word "sound," the concept of sound, is too abstract for them to put in the same category as an object -- except as something that produces a sound.

4: What about a shadow? Or a reflection in a mirror?

B: Again I would say that that's a property, rather than an object. I think it's really about the same sort of distinction.

5: What is it a property of?

B: It's a property of the interaction between the light and the object which is casting the shadow. In other words, the shadow is evidence that there is an object between the light source and the shadow. Okay? If the object were not there, you wouldn't see a shadow. You would just see the light falling. If the object is there, you'd see a shadow, which is a property of light and the object in between interacting. That is evidence for the presence of an object. In other words, we infer that there is an object blocking the light when we see a shadow. Does that make any sense?

6: It does, except that when you said an object has properties, and properties are those things that you can see or hear or feel . . . And you see a reflection? So wouldn't that make it an object?

B: Yah, what you're really seeing is not a reflection. What you're seeing is the object, reflected. You're not seeing a reflection.

6: I had an interesting thing today. I teach the kids economics and told them about material goods being distributed to the schools, and they understand now the word "goods," meaning material things. And I asked them to give me an example and one child said a radio program that's distributed in the classroom.

B: Yes?

6: And it really isn't.

B: Well, it's distributed . . .

6: It's not material, though. So it came up in that.

B: Again a radio program, you know, is really a property, you know, by this definition. It's a property of the interaction between certain components in the radio set, and radio waves, which according to one theory are particulate -- are actually matter. But now I think this begins to go way beyond what we really need to consider at this level. Now I'm not too sure that I'm actually equipped to argue the philosophical side of this distinction.

Going back to what Miss Green said before, if we stick to our definition of object, we're not going to run into too many problems. If we do run into the reflection problem, we can say -- well, what you see in the mirror is really the object, as it is reflected. What you see on the ground when you see a shadow is the object. You don't see it as you would see it reflected in a mirror; you see it as it blocks light from a source -- street lamp, sun, some other source. But actually what you see there is an outline of the object. It's yourself walking down the street with you. What you see there is yourself. We call that a shadow. It doesn't mean it's an object. It has a name and that may tend to throw us off a little bit. Well, I think that we can dispense with that problem unless there are some objections at this point.

And I'd like to talk about just a couple of words, and ask that you too, perhaps, think about these as you are going through your experiences with your classes and as you're working with science and think about the importance of clarity -- clarity in communication. I'm not sure that I am at all times being terribly clear here.

We started out with object and property. Later on in this sort of sequence of activities that we go through with children, we begin to talk about objects -- more than one object -- and when we talk about more than one object, we say that these objects interact in some way when they're in the same vicinity or perhaps not so close to one another. They can interact in different ways. We are interacting, for instance, here at a distance from one another. We're not touching one another directly. You are, perhaps, interacting with your pencil and your notebook at this point -- in a little different way than we are interacting. Yet, objects interact. And so we begin to think of interaction.

Interaction can be, let's say, direct contact. It can be interaction at a distance -- sound, radio, radio transmitter and radio receiver interacting. We don't really have to worry about radio waves, electromagnetic radiations, not with a second grader. We don't really need to worry about that. Even when we get much more elegant in terms of our science knowledge and content at a higher level, we're still dealing with models -- we're still dealing with theories. And there are often alternatives -- several ways of explaining thing and object. Okay, objects interact; and when we begin to look at interaction, we may begin to took at specific systems of interacting objects. Not all object interacting everywhere all at once, as naturally we have to consider this, not infinitely expanding, but expanding universe of objects which are interacting.

I taught some second graders a few years ago this concept of interaction so well that they were totally unable to consider anything as not interacting with anything else. They told me that I was interacting with a bridge out here on the highway now because I am touching the floor, the floor is touching the ground, the ground runs all the way under there and comes up and holds the bridge. Well, that's fine. The thing is, I'd like them to be able to look at me and the floor now, and cut out the whole rest of that stuff, you know. And I had really impressed on them the notion that everything is interacting so much that they were totally unable to consider sub-units of this whole system. They were totally unable to look at sub-sets, or sub-systems.

So we begin to think in terms of a system, which is, two or more objects interacting, in some way, and where we have a complicated system like a social system, for instance, like a school. We may not want to look at the entire school at once. If we are a science teacher, maybe we may want to look at the science department. An English teacher may want to look at the English department. You know, and if we are a core teacher, we are not going to look at the system in the same way we would if we were a specialist in reading only and didn't teach some other subject, or a specialist in science only; so our interpretation of the system would be a little different. So it may be very important for us to think in terms of sub-systems.

Well, these notions alone carry us in terms of curriculum, up through -- up three years, about three years in science. From this we begin to branch into a little more sophiscated ideas. We begin to branch into basic relativity theory, for instance, in the third grade. Describing the position of one object in relation to another object, describing the motion of an object in relation to another object which is sort of a fascinating game to play with third graders. We're already going a little high. This is just thinking now in terms of basic words and the way they sort of lock together, building on objects which have properties.

You say that they are objects because they have properties. Objects are capable of interaction -- they don't have to be interacting. Children will often say that they -- objects are doing something in the interaction, and it's very tough sometimes if the system is not a moving system, or a changing system, for them to think of the objects as interacting. For instance, table, the floor and the chair defined as a system -- they're just sitting here. The child will say, if I ask him -- well, about some objects, he'll say that they're working together. He can describe these objects. He thinks of them as being in motion somehow and if there is motion in a system that there is interaction going on. Well, today, I'd like to get you to look at some objects. So clear a little space in front of you and then in pairs, do a little observation. Would you send one member of each pair up please? Please do not open these objects.

(unintelligible question -- 1 minute)

All right. You, me and the air. You can consider as a system . . .

T: That would be two objects. A piece of chalk and a blackboard?

B: Right. And we might want to throw in the hand that holds the chalk if we feel like it, but we don't need to. We can consider the chalk and the board alone and just say, okay, we know the hand is necessary to hold up the chalk. So we don't have to mention that, but your system of interacting objects can include any objects you want if you can put them in the system. If you want to exclude some objects for certain reasons, fine. Depends on what you're looking at, depends on what you're looking for.

The scientists, in order to make sense of events, of objects in the natural world, oftentimes has to exclude huge amounts of information from consideration in order to be able to concentrate on just a few details at a time -- to find out more about those details. Otherwise, he gets so much input, he gets so much information back from his environment -- from observing events in his environment that he can't make any sense of it at all. So he has to look at a highly specialized part of that environment and nothing else. He has to pretend as though nothing else exists for the moment. This is what we do in experiments. We control a part of the variation in our world around us. In other words, we are trying to keep it the same, and we manipulate certain other parts of the environment around us and we see what happens as a result of that manipulation. Okay?

Well, a very good example of this -- suppose you have a group of teachers coming in to an inservice program. You're manipulating something, aren't you? You're giving information to the teachers about the program. So you're actually manipulating the experience of the teacher. The teacher comes, sits down, listens, takes back some ideas, filters through them, throws away some, keeps some, uses some, talks about some to other people. Okay? So we're actually manipulating the experience of the teacher and we're controlling all the other teachers outside that program. In other words, we're doing nothing to them. We're treating them all the same way.

Now suppose we wanted to find out what this treatment did. Let's say in inservice program A, and suppose we ran 400 inservice programs with science teachers who were sitting here at the same time. How would we ever know, and if these were all different, how would we ever know where the change came from if we observed any change? So one of the ways that we begin to find out whether or not a given treatment makes a difference is leave everybody else alone. Try to keep them away from the program; in fact -- but that's something you can't do because, of course, people have experiences . . . and as some of you have already mentioned to me, you are introducing people in your school to what it is about -- the program you're talking with people outside of the program about -- in the program, and so it's impossible to keep it unto itself. But sometimes we have to pretend it's left unto itself.

Look at the object in front of you. The brown paper object with a rubber band twisted around it double. Do not pick it up. Do not pick it up. Do not look inside. And I would like you to -- on a piece of paper in your notebook -- tell me what you can about the contents. We've got some sneaky people around here. She was going so fast that she would have been in there if I hadn't caught her. You may touch the bag; you may smell it.

(2 minutes working at task)

1: One, two -- I'd say, three.

B: Tell me what's inside; write it down on your piece of paper. See if you can tell me how many objects.

(2 1/2 minutes working at task)

B: Okay, everyone have their answers? All right. Let's go around the room and let's ask first, how many objects in your bag? Okay. Let's begin here.

1: Four or five.

B: Okay.

2: Three.

B: Okay.

3: Seven.

B: Okay.

4: Six.

B: Okay.

5: I think I feel five. I thought four, but I said five.

B: Okay.

6: Eight.

B: Okay.

7: Five.

B: Okay.

8: A lot of little ones.

B: Okay.

9: Nine or ten.

B: Okay.

10: Six.

B: Okay. Now, let's see what the objects . . .

1: Are . . .

B: Well, you shouldn't say what the objects are, you should say something about properties of objects; but I'm going to jump right on to -- what do you think some of the names of the objects are? See if you can list as many as you can without opening the bag.

I see a pretty good idea over there. Mrs. _____ has drawn a line under the object which she found with the bag rolled up, and then below the line she's putting objects -- after she unrolled the bag.

(3 minutes working at task)

Okay, draw a line under all the objects you have picked now and then you may look inside. Dump all of the objects out on the table.

(1 minute working at task)

Okay. How many of the objects that you have on the table did you actually predict?

1: Five.

2: You're counting several of the things, right?

T: No.

B: No, each of them. Oh, yah, one kind of object, but . . .

(1 minute pause)

Okay, now what sorts of information were you able to get through the paper bag?

3: The general shape you expected? The big problem was that because of the magnet, many of the metallic objects were sticking to it and therefore misled -- because -- especially when the bag was rolled up because you didn't have the freedom of movement. With the bag was rolled out, then you could separate them, then we felt the magnet -- because we felt the nails.

B: Okay. Any other ideas on this topic?

4: Wait.

B: Yes?

4: Size.

B: Relative to . . . ?

4: One object to another. You feel where the weight was in the bag.

B: I see, you mean the weight was distributed differently in different parts of the bag?

4: Yes, and the size also.

B: Okay. Okay. Let's say, just how accurate we're making decisions about what's in the bag. Is the information that you were able to get by feeling through the rolled-up bag?

5: Very inaccurate.

B: So, your perception then of the objects -- a recognition of the objects from your previous experience, perhaps, was a little limited by the conditions under which you are perceiving the collection. What happens when you open up the bag a bit? You unroll the bag?

5: Oh, we can do a better job.

B: Why? Why?

5: You can feel the actual shape. You can see it.

B: Okay, so there are several. There were several things involved here. What's one of them?

7: Well, it must be that we could see it.

B: You could see?

7: You could see the shape.

B: No, I mean when they're in the bag, but you have the bag unrolled. We're not quite to the point yet of having them out on the table. But when they're in the unrolled bag . . .

8: You can feel the shape though.

B: Okay.

T: They're spread out.

B: Okay. Once it's unrolled? You couldn't feel that when it was?

8: No.

9: I didn't feel the nail.

B: So your possibilities for interpretation was extended a little more when the bag is opened? How about when you dump all the objects out on the table? Then what?

1: It was obvious.

B: What was obvious?

1: The things that were in it.

2: We thought we knew, but there were some objects that we didn't know the names of. And we didn't know the name of a clip . . . Even when we saw it, this thing, we didn't know what it was.

B: Can you describe it for us?

2: I could feel it. I knew exactly what it felt like in the bag.

B: How did it feel when it was in the bag?

2: It felt -- a cylinder on one side and flat, a cylinder on two sides rather -- and flat on two sides and I felt that there were projections on the ends. And sometimes we felt the wire; sometimes we didn't feel the wire.

B: What more do you know about the object now?

2: I don't know anything more about the object except that it's made in Canada. I don't know this object.

B: Okay.

2: The color, you can identify the color now.

B: So you're still faced with the basic problem here that it is not a familiar object to you and that, but -- you're able to find some more properties of the object. And you're able to actually describe the object even though you don't know what it is. And actually if we were to pass the object to someone else, what's the likelihood that they would be able to come up with fairly much the same properties? See what I mean?

In other words, the properties among people of our particular level of experience are not going to vary too much. Uses here, or names for the object, might vary tremendously with our experience. The shape of the object -- some of its basic properties such as having wires sticking out of it -- one red, one blue -- having a brown case, having a little something or other sticking out of the end and it turns. These properties are not going to change too much and so this gives us some sort of meeting ground, let's say, in terms of communication.

We're actually able to talk in a fairly unambiguous manner about properties of objects. When we get into certain more esoteric properties, of course, we may find differences due to evaluation in terms of our own experience. Some of us may perceive finer grades of color or texture than others because they are trained to do so. But people might actually have a visual impairment and not be able to see certain shades of differences in color, or certain basic colors. But, generaly speaking, with most observers, we'll have fair agreement on properties. I doubt that we can say that about the name of the object or its use. Yes?

1: I was going to say, "It was interesting to note that the objects that were more readily identified when the bag was rolled up were those objects with properties different from most of the properties of the bag.

B: The greatest amount of variance is recognized more easily.

1: The things like the wire -- along the bag, whereas the battery didn't, and it was much easier to identify.

B: How about, for instance, a wire with coating and a wire without coating? Okay. So the variance here is much less; the variation between the properties is much less in that case and so we cannot discriminate, we cannot select between the two in the bag. So we're selecting on the basis of greater variation, okay?

I was just thinking -- I didn't invent it that way -- but I was thinking that oftentimes children are like a bag of objects that we're working with. I don't want to follow that too far, but sometimes we make funny assumptions about what's in there, and about what a child is thinking, perceiving. Sometimes we have to be very careful. It just occurs to me -- and ask the child what he really means when he says something or ask him to amplify a bit -- a little, perhaps. Sometimes, I wish I could think of a beautiful example. I heard this afternoon of a case where a teacher was getting to this point. At any rate, what I'd like you to do right now is to light a light bulb. Do not share information with anyone except your partner.

(signal)

If you need any other objects, I have a box up here which has spares and alternates, so that if you find that you have problems or something you need that you don't have, come and take a peek in the box.

(25 minutes of working at task)

[Many comments are decipherable in this interval from a nearby group. Unfortunately, there is no clear relationship between these comments, perhaps, because we can not see what is going on. In addition, some comments are "muffled."]

Please let me have your attention. Would you put all of your objects back in the bag, please?

(4-minute pause)

You have seen this before. I think you know what to do with it. If you will proceed to rapidly score these three pages . . .

(40 seconds pause)

B: Now if you do not remember how to score, let me give you a cover sheet. Here's a cover sheet. Be sure to put your name at the top.

It's not necessary to put your school on this one, just your name.

(6-minute pause)

Remember that you should not go back. Just move directly through each item, marking as rapidly as you can, how you feel, about these words in relation to the concept at the top of the page.

(4-minute pause)

When you are finished, please hold up your papers so that I can come around and pick them up.

(2-minute pause)

I'd just like to make a brief announcement when everyone's done. I'll give you another minute or so here.

(3-minute pause)

Now I'd just like to make an announcement before -- I'd like to make an announcement before everyone gets away. Several things. Number 1, you will be receiving in the mail the last week of the study -- now that would mean the last week of March or the first week after you come back from Easter Vacation, another questionnaire to be filled out with, and I will have a self-addressed and stamped envelope. And I will ask you to do that. Stick it back in the envelope, and send it to me. At that point when I receive that return from you, you may consider that our relationship -- professional relationship is completed.

Now I would like to say this much. I am available for advice or help by telephone, or in writing at any time. Don't hesitate to contact me. Miss Green, of course, is in the district and will be in schools, and she works much closer to you than I do. Unfortunately, I'm teaching every day and I have some obligations which keep me from coming into the schools to visit with you during this implementation phase. That's why we have to have these professional observers coming in. Now, at any time, do not hesitate to contact me. Let me know about difficulties you're having -- to ask about, ask for advice or ask for support in one way or another, or to just tell me how you feel about it. Please do not hesitate. I don't want you to feel that I am, you know, a distant researcher who's inaccessible. I am accessible, if you want me to be accessible, but that's up to you. This is your decision to make. I really cannot think of anything else at this point, except that I'm hoping that your materials will be in the school on Friday morning or on Monday morning. You will know, before the observer comes, and you will have the exact dates each week -- the same time for the four visits. Yes?

1: . . . let's say we would not be in school for the third visit, would you wish us to contact the observers or yourself?

B: No. Please do not. Do not even worry about that. If you know in advance that you're not going to be there and you would like to save us the trouble of coming, then please say so in advance, or you can give me a call in the evening or something like that. I'm usually at home late in the evening. Don't hesitate to call very late if that's convenient for you.

2: One more thing -- how long should the lesson be when they come in?

B: This will be strictly up to you. I would like you to decide how long a period you would like to teach, what concept you'd like to teach, how you'd like to teach it, and everything else. Our person will simply come in, say "hello" to you, introduce himself to you. The three people will be two ladies and one gentleman and they will let you know who they are. They're skilled in dealing with the schools since they've been in them for so long, and so they'll follow all the protocol. They will not interfere in any way, or comment on what's happening. They do not know, by the way, what I'm looking for either. Which is a rather interesting thing. They have no idea what I'm looking for. I have told them what to write down, but of what I have told them to write down, they have no idea which parts I'm looking for and which weights I give to them. See, I mean this is another necessary part of the experiment really; otherwise, they might systematically tell me what I want to hear which would be just as bad as, you know, contaminating the study . . .

3: I would assume that you do not want official -- regular lesson plans -- written lesson plans.

B: No, no written lesson plans necessary. No written lesson plan, and um -- right, right, your routine. This is your thing. We're coming. You do it as you like. Are there any questions before we break up? The whole group? If anyone wants to say anything individually, please feel free afterward. Okay.

(Some discussion about getting rides home for those who needed them. Much noise, with group moving out.)

(end of tape)

APPENDIX H

Training Session 4: Entry Code:

February 18, 1970; tracks 2 -3

B = Mr. Bartlett
Numbers = Participants

Start index 92 (about 10 minutes of the ladies' gossiping).

B: Well, now one direction about signing the sheet today; you should be sitting with your partner. Please, you and your partner sign the sheet one after the other, so that your names are together and then I'll just ask you to put a little bracket at the left margin to indicate who's partner with whom. And I'll just start the sheet over here and you just pass it from table to table.

(5-second silence)

That saves me a lot of bookkeeping, which I appreciate very much. I think that we can --- as we're working along here; we can probably go ahead and begin. Miss Green will be with us in a few minutes. She is stuck with some telephone work downstairs; she'll be along shortly.

All set? Beautiful. Thank you so much, ladies; that's a great help. You have no idea how long it takes one person to match all these things up. Just leave them sitting right here, all right?

(15 seconds)

What I would like to ask first is: what do you think, what do you feel at this time about what we did last week? I'd like you to reflect on that for a moment and perhaps organize your attack here and then let me know sort of what you think as an individual, as a member of a pair, as a member of a workshop, about some of the questions and some of the ideas that were put across last week.

(4 seconds)

Whenever you feel the urge. Just go ahead and testify, as they say.

1: I think we asked other people what they thought about water.

B: I see, a little testing of people outside of workshops.

1: To see if everybody else was as dumb as I was.

(laughter) (5-second silence)

B: Well, I've heard several comments along that line. Perhaps, you did some testing at home or in school.

(10-second silence)

B: Anyone else have any ideas about what we did last week? Questions?

2: Uh, I was annoyed because I didn't get any answers from you and I was thinking all week on this crazy thing. I'm really concerned why you didn't answer us on it -- or is there a reason?

2: Are you testing us or what?

B: Well, how does it seem to you?
I mean I have a feeling that the reason that you asked the question is sort of based on a feeling that you have, and so why don't you come out and tell us what that feeling is.

2: Well, it's sort of almost like a psychoanalysis type of thing -- how were we reacting to your . . .

3: (Two-second question about Wednesday and Tuesday Groups)

B: Well, uh, actually the groups are different. They are different only in one respect and that respect I can't describe to you unfortunately. However, I have observed some differences which are not produced by me -- at least not knowingly -- between the two groups. It's a rather interesting thing (2 seconds -- someone coughed). But I think your question is a legitimate question. You know, how do you feel about this procedure, for instance? If you -- now do you feel that I'm violating some sort of expectation that you have, let's say for a workshop?

4: I feel we probably will get some science information out of it, but I don't feel that last week we learnt too much about science. I think that we were being researched . . .

5: Well, I disagree with that (2 seconds). I asked what about air and what about water -- grownups, not the children in the class.

6: I feel that we will know the answers by research and by working it out in this room, this week or maybe next week before the course is over, I hope!

B: Yes.

7: Um, I felt that, um, you really wanted to stress procedure rather than something definite that we could teach in science -- a way of the children discovering things which we have not done up to now -- I mean, I can't speak for everyone.

B: No, only your feelings, that's right.

7: Yes, and that mostly it has been lecture and a little bit of experimentation. But the type of thing that you're trying for is quite different for me.

B: to you. It impresses you as being a different kind?

7: Yes, very different.

B: There was a question over here?

8: I just want to comment on something that she said -- procedure as if you gave us the idea of objects just by throwing it out to us and letting us discover it, whereas this is what we should try for with the children -- let them experiment on their own instead of telling them what it is. This is the way I felt.

B: Any other feelings around the room? I'm sure there must be a few.

9: I think we should appeal to the child's senses and I think you were trying to get that across to us last time about the sense of touch, the sense of sight . . .

(10 seconds -- unintelligible)

B: Well, I don't know; perhaps we are, perhaps we are saying something. All done? Thank you. I'm sorry, here we go. Boy, they'll tell us, won't they? Do you want to say something? Say it to the group because I want to share all of this.

1: Now I said I felt more confused when I left afterward than I did before. I must say an awful lot of things went through my mind from the beginning of the session and then I tried to evaluate the session on the whole and I still come up with confusion.

(laughter)

1: So, whereas that one of the things that really stuck in my mind -- how did I feel about my partner. I think that that one stuck with me a little bit more than -- I could understand basically the technique of drawing it out -- objects and non-objects individually -- I thought that either through research or discussion when we came back that would be settled, so I had a way of . . .

B: That was something that could be resolved.

1: Yeah, but I never could get it through my mind exactly why you asked me about my partner, because first thing that came to my mind because you said "how do you see your partner?" And the first thing that went through my mind was, you know, 40-40 vision.

(laughter)

And I kept saying maybe I'm a little dumb or something because everybody else was coming up with all these nice answers. And I really had not been so involved in what was going on, that I hadn't really given my partner a thought one way or the other.

B: I think you're telling me something very interesting here. And before I begin to say anything else, let me refer back to _______'s comment before and try to relieve her mind. No, it's not pyschoanalysis, because I think that's sort of -- isn't applicable here -- something to talk about. It is important to say, however, that

B: we're looking at interaction and we're looking at interaction between ourselves for a very specific reason, and you can mull over that -- and I'm quite sure that there are already some well formulated answers from some of the comments that I've heard here. Yes?

2: We've tried the same thing in the lunch room with one group of teachers and had just the same kind of reaction as we did here. We felt pretty good about it because we knew more than they. But then the second time one teacher just blew the whole thing.

B: Why?

2: She had the answer immediately.

B: What was her answer?

2: Well, she said immediately it has to be an object. It must be, she said, the only thing that's not an object is a thought. That's what she said immediately -- an idea and a thought. So that kind of stopped us and we didn't try again. That was it.

B: Well, you had found out something.

2: I thought she should have been here and she might have really jinxed the whole thing, I don't know.

B: Uh huh. Okay.

3: I think the whole question of objects or non-objects is secondary to the whole point which is the learning process. And I think it could have been demonstrated with any subject rather than that. I don't think that was the primary concern.

B: Well, that's a pretty interesting observation.

3: I couldn't understand why that plant was here. You know you never referred back to it again. You know we mentioned the plant was an object. I think you're putting us in the position of the child. Will they be as observant as we are?

B: How do you feel about it?

3: I think it's great because I do it with every subject anyway.

B: Well, I just wondered if you sort of didn't like me because I was trying to do that? If you thought I was trying to do that, now, I'm not saying that that was what I was trying to do.

4: The whole process we went through last week is really the discovery method, because when you plant the seeds of doubt in the child's mind . . . and they're going to try to find out, clarify it -- try to find out the answer some way. I think that's . . .

B: That's reasonable. Well now, let's go back to something -- yes, I'm sorry.

5: I wanted to say, I started to think about which children in my class could work together well. I thought of two that sat, first. She's a very -- she isn't slow but she's fearful of trying anything. She's extremely fearful. She comes from a foreign country and the boy next to her is almost a genius. And I thought to myself, if they ever work together on anything, he would really give her a terrible time and I was thinking of shuffling my class around so that there would be four people that could work together very well. I wonder whether that's wise or whether you allow that?

B: How do you feel about it?

5: Well, I know the children that could work together well. I know them. But then everybody that would be left over, wouldn't be able to work with anybody, you know.

B: Well, you know, I find that -- I was thinking today about this; in fact, because I have group problems. This morning -- the next to the last class that I had was the sixth grade. What we call our six-red class, which I think is a very bright class in many ways, and yet in some ways we have several kids in there who are resistant to learning as I think you have in practically every class, who have beautiful insight into certain problems -- are able to do inferences based on evidence very very well and yet for some reason they're always getting F's and D's and other horrible grades -- or 0's and they just never do anything. And one of the kids -- the main reason he can't do anything is because he can't write. He's about 11 years old now and it's kind of a handicap, you know. And this child doesn't come from a disadvantaged background -- he comes. That's a booby-trap, Miss ________, I couldn't figure out how to unlock it so I left it. He doesn't come from a disadvantaged background -- a background where his teachers have systematically avoided the problem that he couldn't read and all these things we keep hearing about these days. The kid lives in a penthouse on Park Avenue South, you know, and his father owns several factories that manufacture dresses and they go to Sun Valley skiing at Easter Vacation and they go at Christmas to Switzerland skiing, and the parents take them to museums, send them to good schools. But the kid doesn't write. He hears well, he sees well, he thinks reasonably well, but if you had to grade a composition of his, you'd just be tearing your hair out. Uh, well, where do we put this kid? There's another boy in the class; he works very well with, and of course at this age they're very boy-girl conscious, and so they say, all the boys want to be together and all the girls want to be together. The girls are very democratic these days. The girls say, "Well, I guess we really ought to have a boy in our group," or else, "we're just becoming too isolated as girls. And some of the boys say the same things. It's a very interesting concept. At any rate, there's a little girl in this class, Mary. And Mary, oh boy, Mary hardly ever says anything. She writes well. She reads well. And nobody likes her. Nobody likes Mary, absolutely nobody in the entire class. What do you do with Mary? No one will work with her. Now I ran into a problem a few weeks ago. I assigned them to a team, a pair to work with their mice. They're raising mice and observing mouse behavior.

And we're analyzing mouse behaviors: the mouse is walking, well how does the mouse walk? "Well he puts one foot in front of the other." I said, "Oh no, which foot goes in front of which foot in which order?" "Oh well, that's hard." I said, "Sure, it's hard; what do you think I gave you the assignment for, Mary?" So the little girl that was working with Mary went home to her mother in tears: "I have to work with Mary and I have to work with Mary in Math, too." Well, it was an accident that I did it because I just went down the role book: this one, this one . . . The child goes home to her mother crying and her mother calls, "You've got to do something about this, my child is totally destroyed, she has to work with Mary." Well, what do I do with Mary? Well, the mother said, "Perhaps she can work with so-and-so because this child is sort of flexible, a little more flexible than my daughter is." The next day a note came from that child's father. So-and-so, M.D. says: please do not put my daughter with this other child because . . . Well, I ignored the problem and I put them in double pairs today. And here they are, four here, four here, four here, and there's Mary. Mary's chair and the other three girls' chairs: bump, boomp, boomp. And the other three girls are all sitting there doing their work and here's Mary doing her work. Now, I don't know if there's anything I can do for, about, or to Mary that's going to help. I really don't know. And I was racking my brain today trying to figure out some way of integrating this child into the group in a little different way. She's a sweet child; she's a bit of an itch at times, and she gets on people's nerves, and she doesn't give a darn what any of the kids think of her, which is, of course, the reason that she's in the predicament she's in.

Well, at any rate getting back to what happened last time. (Signal) I'd like to go back to your comment about my distracting of your work by asking you to concentrate on interaction with your partner. I would like you to think for a moment, how you feel about my asking you that? How do you feel personally? This is not something that has to be a group decision. How do you feel personally about my asking you?

1: About what?

B: About the questions I ask, and so on.

2: It's not a question of what you're asking. It's more of a you know.

B: Right.

2: As far as your asking me the question, it didn't bother me a bit.

B: Okay. Now how about formulating an answer?

2: Formulating the answer bothered me because I didn't have truly an answer no more than I had given it a thought one way or the other.

B: Well, I think that's probably usually the case.

2: I -- it dawned on me -- in the two of us talking -- I began to formulate an answer, but at the time you asked questions . . .

B: Well, we've heard from one.

3: Why did you let us pick our partners? Why didn't you pair us off?

4: Some of us were already paired.

B: Those who came from the same school had to work with the person from their school. So half of the participants, actually ten of the participants here, had to pair off with the person from their school. That's one of the rules of the game. Now the other ten persons had their choice, but of course that choice is somewhat restricted because there were only five pairs to choose, right? And most of the choices were made because, well, you're sitting next to me, you're sitting across from me; so there's not really much choice in the matter really. And as I recall, we had, I don't remember if it was you or not, you were sitting over here, and your partner was sitting over there and you were paired because you were the last people. So you had no choice at all. But what I'm saying is that every time someone makes a choice, you have fewer choices to make. Right. So actually you were in the same boat, for instance, as people who came from the same school. You might just as well be from the same school for practical purposes.

5: . . . asking questions?

B: No, that's all right, go ahead.

5: Is it the fact that Mrs. __________ and I had never met and that we had chosen each other, maybe because we didn't know each other, we only would know each other by question and answers, where -- I forgot the name of these two ladies -- had already known each other so they know how they maybe think and they worked together before.

B: We're asking them -- remember the kinds of questions we're asking them. You see, the kinds of questions we're asking are not the average kind of question you would ask about a person you work with, about a colleague. They're of a different order perhaps. There's such a thing as working with a colleague, and there are certain things that one talks about -- with a colleague. And it's all on a very objective professional level, okay? The sorts of things that I've begun to ask questions about are not necessarily on an objective professional level.

1: Well, was this how you planned the class; that we would have ten couples that came from the same school?

T: Oh, you're laughing!

B: Yes.

1: It is, you did that on purpose?

B: Oh yes.

(laughter)

B: Well, this is a part, this is a part of what we call the experimental design. In other words what we're looking, what we're looking at here is pairs who come from the same place and pairs who don't come from the same place. Now, obviously if you're interested in looking at how people work together, you're going to want to compare one sort of condition with the other, and one doesn't leave that sort of thing to chance. Otherwise, it's rather messy research. So that may clear up that problem in your mind. By the way, the Tuesday sessions are organized the same way. Half came from schools in pairs, half came from schools as individuals.

2: Excuse me, do you have some that are here from one school and another teacher from the same school on Tuesday?

(5-second buzzer)

2: One teacher from the school; that's it?

B: Right. If it's one teacher from a school, it's only one teacher from that school. Actually involved in the total study, we have twenty schools from which we have individuals and ten schools from which we have pairs, which gives us 20 individuals and ten pairs. And, of course, that's a kind of a problem you know in the school district and this is one of the things that Miss Green was very insightful in, when she suggested -- you know -- we had to have 30 schools for the study and there aren't 30 schools in the district. And what a beautiful idea that we could bring together schools -- let's say parochial schools as well as private schools. It introduces another interesting, very interesting facet into the study -- interaction between . . . Well, at any rate, that's getting way off. I'd like to get back onto the process track -- and the process track in the sense that I would like you to go back to thinking about the question I just asked in which I got one response to and after that we got side-tracked again. I wonder why we keep getting side-tracked when we come to that question? I'd really like to get a sample of opinion about personal feelings. And don't worry about sticking it in because you don't have to spare me.

1: Personal feelings about being asked the question?

B: Right. Being asked: trust, openness, competence, and so on -- the relationship.

G: Actually you mean, how do they feel about being asked, how did they personally feel about, how did you feel about Mr. B.'s asking you that question?

3: Well, how could we have gotten into trouble with a partner, that we had to name ten objects?

2: I don't think trouble is the . . .

B: That's not really the question.

3: No, but because it was only objects that we had to mention we're certainly (someone coughed) without knowing anything about the person.

B: Right. Well, it sounds to me then . . .

3: So I didn't object to being asked.

B: No, no. I'm not saying that you object. What I'm saying is how did you feel about my asking the question?

3: I didn't mind because nothing came up that . . .

B: Oh, I see.

3: That I didn't want to say.

B: Okay, okay, then am I correct in assuming that what you're saying is that under different circumstances, perhaps, your responses would have been different?

3: Sure. Yes.

B: But this was a pretty safe situation and so there was not much room for any disagreement.

4: I rather wondered why you asked it, because today, well, everything I read seems to be sensitivity training, sensitivity programs. I was wondering why are you looking for this and where does it fit in here? I mean we're here on a professional basis. Whether you like your partner or not, you're here to do something professional.

B: I didn't ask if you liked your partner.

4: I mean -- I said the wrong thing -- I mean how you feel about your partner, I didn't think should enter into this type of job that we are doing right now. It may but I don't think it should.

B: Well, now this is what I'm looking for, you see. Now what I'm looking for is a perfectly honest appraisal of the situation and what you're telling me is: I don't think this kind of thing has any business in this kind of a proceeding. Right?

4: I don't mind your asking but I don't think . . .

B: Right. In other words, you're not offended by it, but you don't see why I did it. Mrs. _____?

10: I have laryngitis.

B: Oh, I'm sorry. I wish I had a microphone for you. Go ahead.

10: Um, I didn't mind being asked the questions and I didn't know what you were looking for, but I felt that perhaps after the third meeting, maybe we, uh, our answers would be more so what you're looking for.

B: Yeah, yeah.

10: Rather than at the first meeting . . .

B: I see. So you think that there's something sort of built into this that will dawn on you later on, or else you will be explained the idea later on, but perhaps it's not your not asking questions now because . . . Well . . . Okay. That's a good, a good appraisal, I think, of your view. We've heard how many comments now? Four?

1: I was surprised that you raised that question of trust and confidence in a partner at the time that you did within the framework that you did, and I wondered what your real purpose was.

B: Yah, well, I really wanted you to think about it. That was my purpose. Actually . . . you know it just may be that there are certain considerations that are sort of taboo in certain relationships between people. And we were just talking about this a moment ago when we were chatting about these words. We were saying: "Well, you know, after all this is a professional level of work; we're not concerned with these things here. We're concerned with learning some content in teaching, teaching method, and so on. So, what's this all about? Here you're introducing something which gets pretty darned personal -- you know, and even though it may be irrelevant here, I can see a situation in which maybe it wouldn't be so irrelevant and I'm not sure I want to answer you on that, okay? _If_ the situation were changed, I'm not sure I want to really talk about that. Suppose we have a tough thing to do here; it wasn't just finding a few objects. Suppose we had a really tough decision to make and I had to evaluate my partner on those three, and my partner had to evaluate me on those three and we had to show our answers. How would I feel about that?"

Now several of the comments that have been made today would already lead me to believe that several people were perhaps thinking, you know, perhaps thinking, well, "irrelevant," or "well, what the heck is he asking this kind of a question for because after all we're operating at this level and he's digging somewhere down in here and I don't exactly like that." Now the reason I'm asking you how you feel is because maybe feeling is a little different than analyzing very much and so on, and feeling is probably a little less, well, oh, well, it's a little more messy -- let's say than operating on a subjective level on which we operate on most of the time. Analysis, objectivity. Feeling is a lot messier; it's a little harder to put into nice, neat packages.

Um, I'll tell you how I felt last week. When I came in, it was my second training session. I walked in. The first training session, the first training session was . . . lots of talk, talk, all around the room; teachers were moving around the room getting coffee and all sorts of chatter going on. Last Wednesday everybody came in, sat down. There wasn't a sound -- it was so quiet. And I thought what's wrong here? What am I doing? What am I doing to this group? Undoubtedly, I'm doing something to them because they're all just sitting there, and, you know, I can't get anything going and I'm a little worried. And I was getting very nervous. And I don't mind saying that I went home very worried last Wednesday. I was really worried and I told Miss Green, "You know, I've really done something there, and I don't know what it is but I've done something bad. It went just terrible." And I told my advisor, and told her on the phone, and I said, "It just went terrible. What happened?" And I went back and talked to a friend on Monday about it, and I said, "It went terrible." You know, and here I am.

(laughter)

B: Back for more.

1: What about the other people? Did they know each other? We didn't know each other.

B: Same split. Same split. There's still coffee, ladies.

(2-second havoc)

The groups were selected the same way. Actually all were selected with a very few exceptions at random, and assigned to Tuesday -- Wednesday at random, you know as far as this was possible. And for reason we wouldn't expect to come up with any very unusual difference it seems -- and, of course, the first thing that occurred to a couple of the people I talked to about it -- the problem is obviously you're doing it.

1: You're doing it.

B: You're doing it to this group. You're doing something to this group which is changing the response.

2: How do we compare this week as to yesterday?

B: Well, yah, things are very different this week.

3: Then, they were quiet yesterday and we're noisier today?

(laughter)

B: I was hoping they would be, but they were pretty noisy this week.

(laughter)

B: Yes, Sister?

Sister: . . . (3 seconds) When we arrived here, I don't think the coffee was ready. Was it ready? So when you came in, you more or less went and sat down, and when it was ready, everybody who started over to the coffee started talking.

B: Coffee is the variable!

(laughter)

4: Well, were we noiser the second time?

B: Uh, no about the same, about the same. Yes?

1: What do you mean by noisier? Do you mean . . .

B: I mean more talkative.

1: More responsive to your questions?

B: No, it wasn't that. It was in the beginning. It was the level. You know you sort of develop -- you have a switch -- I don't know if you have a switch. I have a switch inside my head which says permissible noise down here, and not permissible noise up here -- this is related to the classroom. Well, I have the same sort of switch in my head that relates to teacher-training sessions, you know, and if the noise is up here somewhere, it's good -- things are going good, because there's a lot of information passing back and forth between the teachers and this is good. And I'm not evaluating the kinds of communications. I'm just saying there's a lot of it going on.

1: This was during the learning process?

B: During the beginning, actually.

1: So what difference does it make at the beginning? I mean, you know -- I guess we came, you know -- because we wanted to learn stuff. I think that should be the concern rather than whether there's more talking going on.

B: I'm not saying it's bad-good; I'm just saying that it sort of throws me off when everybody is just sort of sitting there quietly waiting for something to happen, you know? I mean it really makes me nervous. That's all.

2: Mr. Bartlett, excuse me. I don't think you should feel that way because I think everyone of us was excited last week and rather than talk while you were talking, we were just being polite and we were listening. Is that bad?

(laughter)

B: No. I think we've sort of done this thing; we've sort of gotten this out anyhow and begun to talk about it. Now today, today-- I want to do something a little different. First, I want to ask: Is there anybody who's got any problems about objects?

(laughter -- 4 seconds)

I think it's only fair to ask this question. I'm only asking this just in case someone wants to let me have it about objects, because if you do, please feel free now before we move on to our next level. Yes?

T: You don't want us to work with children? This month?

B: I would prefer that you do not until after the first of the month.

(5-second silence)

Problems about objects? Well . . . I think, yes?

3: I have no problems. I found the answer by reading the manual . . . I'm really quicker now.

B: Good, very good. Now fortunately, one of my jobs here was to cut out most of the materials. Actually the manual you have here is virtually a word-for-word copy of certain parts of a manual called "Material Objects," which is put out by the Science Curriculum Improvement Study. There's a lot of material in that manual that they publish which tends to -- sort of -- well, it's just saying too much. And so I cut out a lot of the excess verbiage and pulled out some paragraphs that say a little something and that's what you've got in here. You'll probably find some excess baggage in this manual too; and when you do that, I think the best thing to do is just put a big "X" through it, so if anyone else happens to look at this, they'll know at least you have evaluated this material in a certain way. By the way, this material is not in final form. This is still the first, what's called preliminary edition. In other words, it has not yet been finally revised. They've been working on this for about six years. This year the new revision is coming out and so it will probably be much better. But you'll find flaws, you'll find bugs in some of these activities, things that you feel are probably not appropriate to your children, and feel free for goodness sakes, to modify the lesson to meet the needs of your children, to meet the needs of your physical situation and so on. This, I think, is sort of an understood thing in using the materials. Yes, mam?

4: You just asked if we still had questions about objects. I do about air.

B: Okay.

4: Because I can't see it, touch it, smell it, hear it, taste it -- but in a bag -- well, I guess I could see it, but I don't know.

B: Well, Mrs. _____ could help with this. I'm not sure.

5: I think someone told me. I don't exactly remember how it came out, that air is not an object because you couldn't see it, you couldn't feel it. But I said, you can feel it. You can feel wind; what is wind? Wind is moving air. So that it has to be an object because you can see it -- you can feel it. So that was the conclusion I came to. But that you could see the air, you could feel it, right?

6: Unfortunately . . . (not intelligible)

B: I think you're looking for me to tell you that that's right. You know it will make you feel better.

(laughter)

Now, yeah! Actually, you've just given me all the evidence, right? What you've done is -- you've just said to me -- now, here's what we can do with certain objects and here's what we can do with air, and I'd like to consider air to be an object. Will you let me do that? Right? Okay. So really, in other words, you have all of the evidence that you need, so go ahead and make your decision. Is it or is it not?

7: Well, is that the evidence that I'm supposed to be using, whether I can sense it?

B: Well, what are the alternatives? (2-second silence) In other words, what else could it be?

(mumbling -- 3 seconds)

You see, actually, you know, you may -- I don't want to push you on this. I don't want to make you feel like I'm saying, well, you better come out and make your mind up. What I am saying here is really, you know -- when a child comes to you and says when you're asking the child to do properties, and the child says, "The table is hard, isn't it?," what are you going to say to the child?

1(new numbering): How does it feel to you?

B: I said, "You felt it, didn't you? Is it hard or isn't it hard? You felt it. What do you want me to do, feel it too?"

1: I'm just saying that . . .

B: Okay (knocks on table), hard, fine. What I'm saying -- you see to the child -- is "You've got senses, you want me to answer your questions for you?"

2: You give the child a confirmation of his question.

B: That's not the first thing I did though. The first thing I did is to say, "Well, did you feel it?" Okay, now the next thing I say to the child is "Give me a property, breakable, for this object." I said, "Prove it." Right. "Prove it" because that puts the emphasis on: you might think it'll break and maybe it won't; maybe it looks like it will break but will it really break? Because there're some cues that you get -- visual clues, taste cues, auditory cues -- some cues that you get that are ambiguous. The object may look like it will break but maybe it won't break. If you look at a window in a school building and you throw a rock at it, you think it will break. Now is it breakable? There's only one way to find out if it's breakable. Now, you may have seen a school down the street where your little friend took a rock and put it through the window (5-second buzzer) and, therefore, you're going to assume that windows are breakable. I'm using drastic examples.

(agreement)

I mean what child hasn't been throwing a ball and it accidentally went through the living room window, went through the super's apartment window or some other place where he's "gonna" get in trouble for it. But suppose you throw that rock at that school window and suppose it bounces off, because it's not made of glass, it's made of plexi-glass. It looks like it will break, but it will not break. Now, there are some things that you can't confirm without trying it out, and I always insist that the child confirm if it's practical for him to do so. Okay? If it's practical to do so. You know, they say, well -- the object will bounce if you drop it and you know . . . Does it bounce? Yes, it bounces once. It doesn't bounce like a ball, but maybe it'll bounce once. So, fine -- okay, you've proved it to me. Good, I'll accept that property.

3: Would you answer the . . .

B: How many times (laughter)? Now, I'm not going to let you talk (laughter). How many times have you asked a child a question and the child asks you back a question-answer? You say, "What color is this object?" It's a young child -- they do know the colors too, well, he'll say "Yellow." What are you going to say to that child?

4: Well, yes, it is yellow.

Sister: If a child says this is blue, and I say, "This is blue" and he says, "blue," I say, "Well, is it?"

B: Now, why? What's your cue here, Sister? What's your cue for asking that question?

Sister: Because I feel the child isn't certain. And I want to make sure he's certain.

5: I still don't feel that by giving that answer -- yes, he's still also saying yes. He thinks it is, he thought it was when he told you. He still doesn't know it definitely; he's waiting for you to answer him "yes" or "no."

B: Right. Now both of these are valid points of view, but they have a different aim. Now what I'd like to say is this: usually when the child answers with this raised inflection, I'm not sure what you call it -- the questioning mode -- the child is trying to find out what's right by asking the teacher. Now, there is a hazard built into this. Number 1, it does not build the confidence in the child that he is able to find out for himself -- that's number 1. There are some places where it's quite appropriate to say "yes" and, therefore, zero in on yellow. In other words, you're training the child to learn yellow and under certain circumstances, it would be valid to say "yes" because the child really needs to know it is yellow or it is green or something else, because he really just doesn't know anything. On the other hand, you should definitely nip in the bud, in my point of view -- any tendency of the child to use the teacher for continuing verification, because if you don't, the child ends up in the long run having no confidence in his judgment whatever. He has confidence in the teacher's judgment and one day that child is going to run up against a problem because he will find that the teacher doesn't know everything and this is a sad day for you because you have lost the confidence of the child for evermore. Not only that but succeeding generations of teachers have also lost their confidence because of the way this child has been brought along. Now, go ahead.

5: .... I think we're really not talking about the same thing. There are certain things -- like is it yellow? I mean it either is or it isn't. But if a child says to you, "2 and 1, is that 3?" Well, naturally you would let that child say, "2 and 1 -- 3, is it three?" I mean the child could figure it out for himself. I mean he could do that. But is it yellow; he really can't. I mean it's not worth . . .

B: Just a moment now. Can you ask the child, "Well, what do you think?"

(comments -- 4 seconds)

B: Okay. Perhaps we need a better example.

6: My son always had trouble with the blues and the greens. He is colorblind. When he was little, he used to ask me all that stuff.

B: Very good. Very good. Maybe we could just go -- you know -- to who discovered America?

7: No, but what she said, "Well, are 2 and 1, three?" It's an excellent example.

B: It is an excellent example because it's an example that you can work out concretely, too. You can take these sticks and put them on the table in front of the child and you can say, "Well, are 2 and 1 three?" and the child says, "3. Maybe, maybe not." You say, "Well, put two down there for me and then put one down there and then put them together and tell me what you've got. Have you got four or five, or two or three, or what have you got?" And, um, well, pardon?

8: That's much more simple to me.

B: Yah, much more. Now we're not going to press the child by the way on this air thing. This is for you. It's not for the child. We talk with children about this, but we're not going to train them that air is an object. We're going to work with them on it and say,"Okay, does air have properties?" Yes. But we're not shooting for the ultimate object concept at this moment. We're "gonna" work with the child, trying to build an appreciation for all matter as objects, but we're not going to talk with the child about matter. We're not going to talk with the child about phases of matter. We're going to expose the child to gases, we expose the child to liquids, we expose him to solids. Later on, somewhere way above the first grade level, we're going to worry about phase changes, you know, and interpreting the business about molecular distances and all of this sort of thing. We're not going to do this. This is the kind of activity that we can do because we can sit here and talk about it and operate on a fairly abstract level in discussing matter.

9: What about the word "property"?

B: Yes, what about it?

9: Uh, how? Will the child have to know. I mean -- will you use the word "property" to a child?

B: Absolutely.

9: What would you say, "What is the property of this pen?" or would you just casually . . .

B: Well, I would. The way we try to function -- it's very tough in our school because we have classrooms that are as big as from here to the wall and I have 20 kids crammed in there with practically no floor space. But I try to begin with -- to get them all around some tables, or all on the floor sitting around; then I sit down there with them and we have a whole bunch of objects, and I start by saying, "Um," to one of the children, "Will you please hand me this object?" and in talking, using the word object, but I'm not telling them what an object is. So I'm going to decide, okay, Monday morning I'm going to start by saying instead of "Bring me the cup," instead of "Bring me the spoon," "Bring me the box of blocks"; I'm going to say to the child, you know, "Bring me the object which is..." and then describe it.

1(new numbering) Right from the start?

B: Right from the start and consistently. It's tough; it's extremely tough and you find yourself slipping out and slipping back into it because -- and I've been doing this for four or five years now and I find myself still slipping -- still slipping. But if you put your mind on it and just use the term consistently, pretty soon you'll find the kids are picking it up. You're not telling them to use the word "object," you're not telling them to use the word "property," you're just doing it. And then by example, they're picking it up. Well, what's a property -- it's a smell, or it's a shape, or it's a color, or it's a texture. And you can hand them a rough object and say, "What kind of properties does this object have?" They say, "Well, it's square and it's rough." Another object may be round and soft, like a ball of cotton, or something like this.

We pick randomly objects from around the room or from the common experience of the child which can be interpreted and perhaps some objects which are not so common from the experience of the child (signal). Because here he may be a little thrown off by them; maybe a little bit more of a challenge to him. Perhaps, unfamiliar objects of a simple sort to begin with -- objects you might find around your home that the child might not find typically. Great places to find objects of this sort are places like Canal Street in New York, where many of you may have the inclination to go digging around in some of these job-lot houses where they have all kinds of strange objects.

My boss, by the way, running a school on the shoe-string -- for a number of years -- they're still running it on a shoe-string, sort of. She's always trying to get equipment for elementary science and math, and she spent about half of her time, I think, on Canal Street and Vesey Street and these other places where they have these close-out centers, where you can go in and buy -- oh, simple machines for like 25¢ apiece, 20¢ apiece and so on. All sorts of things -- strangest things in the world are found, I guess, on these streets -- of course, which are being eliminated now by urban renewal rather rapidly, but still Canal Street is there, and there are a few others where they have these places. We used to find all sorts of very strange objects, but I'm quite sure, too, the children, once they begin -- and we have the object hunt this unit -- the children will bring in -- you give them a paper bag and they put their name in the paper bag and ask them to bring in an object, or two objects, or three objects which they feel are unique in terms of their properties, we begin object -- (end of tape).

Index 68

B: Please do not share any information with your neighboring pair.

(Index 280 -- after 28 minutes. The ladies are doing the experiment and it is all background noise.)

B: Okay, ladies. Let me have your attention for a moment, please. At this point I would like to very quickly sample your groups, your pairs rather, and ask, beginning over here and working way around -- we'll ask pairs what they think about substances, and we'll put 1, 2, 3, 4, 5, and we will put pairs a, b, c, d, e -- okay, 10 pairs. Now, please give me your present thinking on -- between the two of you -- on what's here and if you have ideas on proportion, you may tell me that at the same time. Okay, let's begin with pair "a."

1: About 1. It must be a mixture, like a part of 1.

B: 1?

1: But it's more of 3. You want characteristics?

B: Well, no. Let's not do properties right now. Let's do substances. In other words, you think it's one, two, three, four, and five. And if you want to tell me the proportion of each . . .

1: I don't know the proportion.

B: Okay. Well, that's up to you. And I'll put a check-mark in the ones you tell me. Okay?

1: It was not two.

B: Not two, okay. But it is one, right?

1: Definitely not three.

B: Definitely not three, okay.

1: Four, maybe a small part of it.

B: Maybe -- Okay, I'll put a small check.

1: And five, maybe part.

B: Maybe part. Okay, pair "B," please.

2: Uh, 4, 2, 1.

B: 4, 2, 1.

2: More of two and less of one.

B: More of two and less of one. Let's put a smaller check over here then.

2: And four looked small, too.

B: Four was also small.

2: Yes.

B: Okay. We'll put a small check here also then.

2: Mostly two.

B: Mostly two. We'll put a big check here. All right. Now, you had mostly one, right?

1: Yes.

B: Okay, largely one. Pair "C," please.

3: It's probably a mixture of four and five -- mostly four.

B: Mostly four but some five. Okay, good. Pair "D," please, Mrs. ______.

4: We're not quite finished.

B: We'll come back to you then. Okay, let's begin in the corner.

5: We had mostly four.

B: Mostly four.

5: And a little three, and it also contains a little of five.

B: A little five and a little three?

5: Yes.

B: All right. Next pair, please.

6: It was mostly one.

B: Mostly one. And what else?

6: Two, three and . . .

B: Two, three and what?

6: Two, three and four.

B: And four. A little two, a little three, and a little four. Okay. Next pair, please.

7: We had mostly one -- one and three -- mostly one.

B: Mostly one and a little three. Okay. Good.

8: Five, four, two and one -- no three.

B: Five, four, two, one, okay.

9: We had four, two, one, and five.

B: Four, two, one, five. Okay, and our last pair.

10: One, three, and four.

B: One, three, and four. Okay. Now we go back to Pair "D," please. Mrs. _____?

4: I think it's four and three.

B: Okay, four and three.

4: We have one -- package one.

B: Oh, package one, but this doesn't refer to one. This is the knowns.

11: This time if you don't tell us, I'm not coming back next week.

(laughter)

B: Oh, what a challenge to my authority! What do you think of that? Gosh. Well, what have we found out here? It seems as though we have everything. Now, what we have to do then is to think: "Well, was it everything and what kind of evidence and are there any limitations, for instance, in the evidence we've collected, or the way we carried out our evaluations?" And actually this -- quite frankly, might have a lot to do with the kind of outcomes you have. I mean the way you've carried out the tests, and in fact I've gotten some very good information from some of our pairs about this. For instance, the use of samples of different sizes doing the same test, or the same size, or with some of your reactants like vinegar or iodine. How many drops do you use, do you use 3 drops and 2 on the other or do you use three drops on them all and so on. This might have something to do with differences that you've come up with. Any other suggestions on this?

The business that we're coming up with, variation -- I can tell you right off it does not have all substances -- that much I'll tell you right now, and in a few minutes I'll tell you something else, okay? But it does not contain all substances, and so we might begin to think something about sources of variance in our findings. Why do we come out with the kinds of information we come out with? And you might think then about how the tests are carried out, just what you've done and how this might affect the outcomes.

Okay, now. I would like for you to do several things. One is right now, before we go any further. Right now I would like to ask, and perhaps, Mrs. _____, if you would take this and maybe you could get it back to us somehow, one way or the other, or bring it next week.

Yah, I just want to announce the questions: What day, and what time of the day, morning or afternoon, would be the best time for you to be observed, and what days should we absolutely not come. In other words, I am going to pass these cards around. Put your name on it, please. I haven't done that in advance. What days should we absolutely not come, and what days will be best days that we can come and let's leave all the rest sort of open because otherwise we end up being . . .

12: Can we return that the next time?

B: Yah, could you put it in an envelope and send it.

12: Because we just became special service, and we have an entirely new schedule.

B: In that case, you will have a special place . . .

12: And I don't remember it.

B: Let me go over the list again, please. Put your name. Put two things: put the best time. In other words, the time which you prefer, the day of the week, and the time of the day. In other words, morning or afternoon. Put down the day that you would prefer to be observed -- morning, afternoon -- day of the week, Monday through Friday; and also put down at the bottom the category number. In other words, if there is a time when we should not come absolutely; then put that. And leave everything else open, please, because we will need to have a certain amount of flexibility in scheduling. We only have three people to observe and they can't come . . .

13: How long will it take?

B: About 30 minutes.

14: At the beginning of March, none of the first grades can have anybody before ten in the morning because we're having conferences.

B: So you have to put that "no," right? Well, put that down then. Put that down. Okay? Put "no," -- not before 10, first week in March if you've got that problem, okay? Under the "no" category. In other words, I'd like to know when you'd prefer and when it's absolutely impossible. And we'll leave everything else hanging and I will try my best to give you the time you prefer and I will try then -- pardon me, yes, we've just been discussing that. You have to put down that you can't come during that time.

(10 seconds -- question)

B: Well, we have to observe each of you. I mean -- that's part of the study. So you have to tell us when you can not . . .

Miss Green: There would not be any observations before ten.

B: Right.

Miss Green: But there would have to be observations that week. That's right.

B: So you have to tell me when to come. Right? When not to come and then I'll just come . . .

Miss Green: Those who are ready, just clear your tables, empty all the contents in this big basket . . .

B: No. No, we're going to give you a schedule.

(As you will no doubt recall, you answered the same questions over and over for at least 15 minutes -- most of them are mumbled)

End of Side Two

APPENDIX H

(2)

Training Session 6:

February 25, 1970; tracks 2 - 3

B: I have sort of messed up something. So I'd like to ask your kind help today in straightening out a detail. I asked you last week to let me know which times would be best, which times we shouldn't come to see you, and then to leave open the times as much as you possibly could in between so that we, if we had scheduling problems with our observers that we could just come at a time which you didn't mention; but that we will let you know prior to coming exactly when we come, and that that time, for next week and the ensuing three weeks, four weeks total, will always be the same. It will be set. I will send you a letter to notify you of the time, but it will probably get there too late for the first observation because since we have only gotten all of the information effective today, we are unable to do the scheduling until tonight. In other words, tonight I'm going to be burning the midnight oil with the schedule trying to work out all of the conflicts between the observers' problems, and teachers' and schools' situations.

Now this will mean that I will probably be on the telephone or will have someone on the telephone leaving messages for you at your school to warn you if the time is -- happens to be an early time because I feel it may take probably at least 48 hours for a letter to get to you. If I take it to the general post office, it usually gets there within two days. I'll send you formal notification but also send you unofficial notification if the time is going to be prior to the arrival of the letter.

Now I need some other information about your class as well -- such as your class size, for instance. I need some other information such as the address to which you would like us to send your honorarium check at the completion of the program. And since some people do not like to receive personal mail at the school, I'd like you to give me that information: class size, and the exclusions and so on. And if you will go along with me, I'd like to fill out another card today, so that I'll only have to run one card. And so I'd to pass these around now and if you will fill out that information, I will write it on the board -- the information I want. First is your name and your mailing address for your check please.

(50-second pause)

First item will be your name and your mailing address for your check. Two: class size, and in the case of those teachers who may be teaching more than one class of science, put the size of your largest class. Three, will be information for observations. First item:

best time, in other words, the time you would absolutely prefer that we come. Second item: "Never" which means, in other words, that's the time we can't possibly come no matter what, and we're not going to specify for what reasons. And "C" is the set we're going to leave out; that's the times that it's possible to come. Day of the week and time of the day, right. In other words, if you have a "Never," like if you have a meeting on Monday morning, you'd say, Monday so-and-so and so under the NEVER category, okay? Good. Or if you say, "Never in the morning," as one of our teachers said, "Never in the morning," because she doesn't teach in the morning -- the afternoon . . .

1: Mr. Bartlett, you know we're having parents' conferences this week and next week. Now I would really prefer someone coming in the morning, but next week it would be impossible for the morning. Could it just be . . .

B: It has to be same time every time or else we can't possibly work out a schedule time for us. In other words, we're not going to be able to reschedule every meeting. I mean, if we did, it would mean contacting everyone . . .

2: (unintelligible)

B: Fine, if it were 10:30? You could say, Fine, come at 10:30 to noon or something like that. Well in that period -- because, in other words, the observer has to see more than one teacher in a morning. Otherwise they're going to be driving from Hempstead or somewhere to spend 30 minutes with you and it's going to be kind of rough on them. So we're going to try to schedule them for like three observations per morning and three in the afternoon to make their day a little less hectic.

(1-minute pause)

When you're ready just hold up your card. I'll come around and pick them up.

(10 minutes largely unintelligibile talk regarding cards)

Well now that we've succeeded in wading through this, it's about time to get down to work, a little different kind of work. Today I'd like to give you a task, a rather difficult task. It's going to require a little space on your table, so anything that you can dispose of by putting it under or on the side somewhere out of the way -- give yourself plenty of room and please send one member of each pair up to the front table to get your bags.

(1-minute pause)

Now, I have passed out objects to each pair. I'd like to give you a little basic terminology first, terminology we use in the SCIS Program, along with some of the curriculum materials that the Science Curriculum Improvement Study has developed. In our previous sessions we have talked about the words "object" and "property." And we've talked about the necessity of developing a rather clear, rather objective, in other words, specific, sort of vocabulary which we would use in science. And we say that the material world around us can be broken up into various objects, and objects themselves are described in terms of their properties. And we also discussed the notion that frequently describing objects in terms of their properties is a little more useful, a little more objective; in fact, considerably more objective at times than it is to describe an object in terms of its use or in terms of an object name at times which may have different meanings to different people and, in fact, meanings oftentimes change even with the context in which we see a particular object.

From objects and properties which we use in the first level of the program, we go on to collections of objects and when we have two or more objects which we are interested in looking at because of the way in which they interact, we call this collection a system. And a system is defined simply as two or more objects which are interacting. Interactions can be of a number of different kinds. It can be a simple touching such as my hand and this piece of chalk -- direct contact interaction. You and I are interacting. We are not interacting in direct contact with one another; we are interacting at a distance. The evidence that we are interacting at a distance is that you are able to hear my voice; I am able to hear your voice.

There's another form of evidence that we are interacting at a distance -- and it's vision. We are able to see one another. That is, if you are turned this way, and if you happen to be looking at me, and I am looking at most of you most of the time, but not all of you all of the time.

There are other types of interactions. For instance, one that's a little more complicated is -- let's say, a color change in chemical solutions. If we have an indicator which indicates the amount of acidity, let's say in a particular solution such as bromthymol blue, which at its normal condition -- let's say neutral -- is roughly blue in color. The intensity of the blue depends on how much of the indicator is in -- let's say tap water, which by the way in New York is very seldom neutral -- it's usually acidic, because of chemical treatments of one type or another. If you add a little vinegar to this solution, it turns yellow. If you add a little ammonia to the solution, it will change (5-second signal). This is a type of interaction which we might call a chemical interaction; it's yet a different type. There is definitely contact involved, but there is a change in the system which is based on something a little bit different than just plain direct contact. It's based actually on the sensitivity of a particular chemical to changes in the acidity of the solution. And so this we call then a chemical interaction.

Systems at times are a little large, a little complex for us to examine and so at times we like to take only a part of the system and look at that system. For instance, within a total school there may be so much going on that we don't want to examine the entire school as a unit at once. We may look only at one classroom. Or, we may decide that even a classroom is a little too complex; we only want to take one reading group within that classroom and we'd like to look at the interaction that goes on within that group. In math we would call this a sub-set of a classroom, or of the school. In science, because the content we are dealing with is a little different, we call it a sub-system. And we usually define sub-systems in order to examine the interactions that exist within them. We're not interested in what's on the outside of that sub-system, but we may want to expand it to include the whole system at some other time, so we will define these objects as a sub-system of the total system. And so each system then is made up of sub-systems, but each of these would have to include at least two interacting objects again. Otherwise we're right down to the basic building block. We're right back to the object. Now I can call this paper bag an object (bump noise; ball hits window).

B: The ball is an object.

Teachers: The ball is an object.

B: I was just wondering . . . At any rate, I can call the paper bag an object. Would you call it an object? In terms of the words we've just been using? As it sits there on the table . . . ?

1: I would say it's an object.

B: Okay, Miss Green?

Miss Green: I say yes.

B: Okay, Sister _____?

3: I think there's a collection inside of it, but the bag itself is an object.

B: The bag itself is an object. Okay. Good. How about the bag and the rubber band?

Teachers: System (general approval).

B: Okay. That's pretty good. I think that we have a little communication going on about our basic vocabulary. Um, interactions -- I'll put down the term "interactions" simply because it's a rather important concept. You and I are interacting. We are interacting with the air in the room. We are also interacting, some of us with the table. Some of us are interacting with pens and pencils and notebooks. Some of us are interacting with the chair. Some of us are interacting visually, some of us are interacting auditorily, and some of these are compounded. They're not just going on as one simple interaction. You have two or three interactions going on at the same time. These basic concepts are the concepts, I would say, that are most important in the first, roughly, first three years of the SCIS program.

After this we begin to get into much more elegant concepts. We spend an awful lot of time practicing on objects and properties during the first level. Then in interaction at the second level, and systems and sub-systems at the third level, roughly the third grade. There's a great deal of repetition involved and I think that most of you would appreciate, not all would appreciate, the importance of repetition in learning, particularly in the first grade. The more you do it, the more comfortable you feel with it, and the more natural becomes the word in your vocabulary. This is one of the reasons we sort of insist that teachers are consistent in their use of these terms with children, especially when they're studying science, and if possible, in other areas too -- trying to relate these words to studies in relation -- in language particularly because, of course, children are studying a lot of objects. They're learning the names of a lot of objects in the first grade. They're learning to recognize the letters and words that go along with these objects. So it becomes a very natural sort of combination.

Well, consider the object in front of you as a system if you will. You may not open it but I would like for you, with your partner, now, and this is going to be strictly partner's deal, so try to keep away from the other two, and from each other. I don't want any particular sharing of information today, except with your partner. Do not collaborate with the other two at your table. And I want you to tell me how many objects are in this system without opening the paper bag, and if you can guess the names that might be associated with any of these objects, write them down. I'll give you just a few minutes.

(7 minutes, teachers working)

Okay, let's have a um -- count now on the number that you estimate in your bag. Write down the number. As soon as you have a number raise your hand, we'll take your number, okay?

1: Eight.

2: Nine.

B: Any other numbers?

3: We can't tell how many, numerous -- many, I mean -- I don't know what word . . . We don't want to give a number. We can't really tell how many there is. There are so many little, tiny things in here. Or it can be one big thing all attached. Why should we say 23 or 28 or 29?

B: I said, why are you concerned about giving me a number? I mean what are you concerned about? What is it that's worrying you about giving me a number?

3: No, I'm not worried about it. It's just that I don't think there's any way you can tell.

B: Do you need to be right?

3: No, say 12.

B: Okay. See, I did it. I forced her into it. Okay. Another group?

4: We were going to say 11, but they said 12, so we'll say 15.

(laughter)

B: You can say the same number if you want.

4: We're going to say 11.

B: Eleven? Okay.

5: Eight.

6: Fourteen.

7: Six.

8: Ten.

9: Seventeen.

B: Well what do you think about the variance? Don't be bashful about talking please. What do you think about the variance here? We have as a low, six, as a high, 25, and I'd say that we have a mean -- somebody can calculate it, but I'd guess that we have a mean somewhere around 13 -- 12, 13 -- somewhere in the neighborhood.

1: Is the same thing in every bag?

B: Good question. No.

1: No? And then you were laughing . . .

B: Yah, well, you know. I think that's a legitimate question. In fact, I think it's a rather important question, and some people might be a little hesitant about asking it like, you know uh, is that the right kind of a question to ask, should I really be able to do that? Okay now, what I want to know is, what's in the bag? And I want to know how many people, how many pairs have listed any items at all. Let's raise your hand if you've listed any items at all. Okay. Good. Let's start over here. We'll work around quickly. Tell us what you think is in the bag.

1: We think there is a little spool battery, copper wire, and clips that could attach to the battery.

B: Okay. Next group?

2: We have a magnifying glass, a nail, a bottle, rocks . . .

B: Keep that -- now, that she doesn't hear it.

2: I said, magnifying glass, nail, a bottle, rocks -- and we see the wires so that's not fair.

B: Oh, gosh, that should have . . . I should have put it in two bags.

2: We didn't list it because we saw the wire.

B: Okay, well that's very nice of you to say so. You didn't have to tell us. (laughter) Okay, let's move on.

3: We have a battery -- a small battery, some wire, some kind of disc . . . and wires and some nails.

B: Okay, that all? Okay.

4: Well, we knew we had a wire, something large and round like a -- I don't know -- maybe a little medicine bottle and something rubbery in there, one of these little snakes or something like that, a little toy thing.

B: Okay.

4: And something that's rattly -- I don't understand.

B: Okay. All right.

5: (unintelligible)

B: Okay, good.

6: Buttons . . . a large nail, rubberband and a battery.

B: Okay, next group.

7: A dice?

B: A die, d i e.

7: A screw or a nail, a battery, button and a . . . or something round without that clip in back of it, or . . .

B: Okay. Next group?

8: We found a bottle, a jar, a large nail, a small nail, a cover that might be the size of a jar, paper clips, and an ink stamper, a button and something that we call hard candy wrapped in cellophane.

B: Okay. Next group?

9: A dice, a little box, I guess, a capsule, maybe a big vitamin pill or something, wire and a clip.

B: Okay. What kind of a clip? Like a hair clip? A paper clip?

9: Curlers. Like you stick in a curl and make . . .

B: No, I've never seen those.

(laughter)

I really haven't. I'm trying to figure out what they are.

1: You know it's like a . . .

B: And then you let go and it clips?

1: Yes.

B: Okay. Last group please?

10: A lock, and a sort of cylinder-type thing. We thought it's a bottle with a cap on, and we thought this little thing here -- we thought was a needle, and a spongy type thing . . .

T: A what?

10: Something spongy, you know, soft, like cotton -- and pencils, and a round disc . . . and something -- there's something in there; it could be a little tinker bell, a little, uh -- it could be a bell . . .

B: It jingles?

10: Yes.

B: Anything else? Okay, now here's your next task. You may take the rubberband off and you may stretch out the bag, but you may not look inside. Be sure to keep the end from coming open. Be sure to keep your neighbor from seeing inside your bag. And draw a line under the objects that you've already listed, and anything that you can add to it, put underneath that line. And something you want to take off your old list, cross it out (second signal). Please be sure to not let any of your neighbors see or hear what you are discussing. You might give them an unfair advantage.

(10 minutes of noisy work at task)

B: Okay, time. I'd like to have your reports now. Please get organized for your reports. And let's begin this time over at this side, we'll take the last people first. And we will ask you which items you have added, and which items you have taken off of your list. Okay? Let's begin here.

1: (Can not understand)

B: I'm sorry. Some people are having trouble hearing, so I'll ask you to start again.

1: We took off the needle, the bell; we added batteries, wire, clips, and a magnet.

B: Okay. Next group?

2: We took off bottle, medicine dropper, pill box and pill; we underlined wire and hair clasp. We . . . battery, nail, mirror, magnet, long nail, spool with nail sticking out and a piece of stone.

B: Okay, next group please.

3: We took off the bottle and the cover and ink stamper. And we put on battery, wire, clip and a large peg.

B: Okay.

T: A large what?

B: A peg. A large peg, which is a nail. Whatever that is . . . you have a concept . . . and I say . . . understand it. Okay. Next group please?

4: A metal shelf clip, a wire, old metal casing, something which -- a round metal box.

B: Are these added or taken off?

4: They're added. We took away the dice and the screw and the round buttons. We added the nails.

B: Okay. Next group.

5: We added another long nail, a magnet and a wire.

B: Okay, take off any?

5: No.

B: None, okay.

6: We took off the plastic bottle . . . we added battery, a plastic bag and a magnifying glass.

B: Okay. Next group.

7: We took off the rattling bottle. We added quite a number: a checker, rock, rubberband, wheel, battery, clip, a magnet and a nail.

8: We weren't sure about the battery . . . about that size.

B: Okay. All right, next group please?

9: We didn't take anything off, but we added an alligator clip, and some kind of a nut that goes with a bolt, a magnetic disc with a screw for wire.

B: Okay, next group please?

10: We took off the magnifying glass, we could say what it was. We added the bottle, we took off the bottle and added the magnet. In addition to that, we said there was some gravel there, several pieces of wood -- flat wood -- and wire, several pieces of wire, and several pieces of flat wood.

B: Okay. Last group.

11: We removed nothing: battery, copper wire, clip, . . . long nail, a picture button, a plain button, a transistor tube, a big vitamin capsule, and a magnet. We don't know whether it's a button or a magnet, so that's between the two of those.

B: Okay, dump out your bags (30 seconds -- much noise, then signal). In case Mrs. Christie thought I was fibbing, I can tell the group that almost all the items are the same; however, there are a few variations in some of the objects -- only a few.

Now, I have a task for you and here is the task, so listen very carefully. I would like, for each pair, without sharing information with anyone else except your partner, without looking at anyone else's combinations, without letting anyone else necessarily look at theirs, or if they see them, you can always point your finger at them and say, now don't do that . . . do your own thing. I want you to invent six systems which have to be different in the objects that they contain, and which have to interact in some way so that you will see a change take place in the system. Now let me give you an example. The example is, let's say you have wires and a battery and a bulb. And if you interact these objects in a specific way, you will be able to see the bulb light. That will be evidence of interaction; it will be a change which occurs because of something you do in the system. Now, I want six different systems and I will give you a time limit of approximately ten minutes. Begin.

Just one word to the wise; leave no stone unturned. Try anything you like. Don't worry about hurting the object, you can't do it. And not only that, but you have to prove it to me. In other words, when you have your six systems you have to show it to me. Right.

You have to show what happens.

If you require additional equipment to make your system work, just come up and help yourself. Here's a box which contains more of the same things. You have two minutes.

Okay, next group, please report. Listen, ladies, now; listen!

1: We didn't do anything, nothing new.

B: Nothing new. Okay, let's tell us about the ones you've found anyhow.

1: Well we had the magnet and the compass and they were sticking together. And the nail and the magnet, and the rubberband holding two things together.

B: That's called a socket. It's a device for holding a bulb in such a way that you can attach wires to the two contacts on the bulb. Okay? The little black object which has metal strips attached to it. It's a form of socket (5-second signal). One has to be attached to each end of the . . .

Okay. Next system? Beautiful, beautiful. Okay. Listen to where they got evidence over here, ladies, just . . . Okay, so you admit you got contraband evidence? Oh, you couldn't help it?

2: We couldn't help it.

B: Okay. We have to forgive you.

3: We have a magnetic rock.

(For 1 minute everyone is talking; can't understand it)

B: A magnetic rock? What evidence do you have?

4: The magnet attacks the compass needle.

B Oh, you mean the compass was better before than it is now?

Miss Green: What did Sister ask, Mr. Bartlett?

B: Sister asked if -- she said something about "Oh, there's a machine going over there," and I said, "Yes, there is. It's a tape recorder, and it's there for a very specific purpose. It's there so that I can get all of my comments down."

5: We thought that perhaps she had said something about the rock that was mentioned.

B: No, no, no. She had just made an observation that astounded her. Now, any other systems?

6: The rock attracted the _____, the rock and the rubberband was a slingshot, the nails were attracted by the magnet, and the compass needle was attracted by the rock . . .

B: How many different systems did you get?

6: We got seven.

B: No, no, no. Those are different systems, all right. They have different objects in them, and you have different forms of evidence. Okay, let's go to our next pair.

7: . . . one is aluminum, I think.

B: Okay, so what are your systems?

8: Well we got the light to work . . .

B: Um, some folks over here can't hear. Maybe we better ask, because your voice is sort of . . .

9: We found that it was difficult to get this motor running, holding, you know, this is nothing, and we had to use a rubberband to hold it.

B: That's a good idea.

9: It's rolling down. Is that interaction?

B: I guess so, if you . . . Yes?

10: Is there an electromagnet in this one?

B: Yeah. It becomes an electromagnet when you attach it to the _____ battery _____. There are, I believe, two inside.

11: What's this thing?

B: That's a motor. And it can be used to move any kind of device that requires a motor of that kind. It can also be used as a generator by the way, simply by turning the shaft like this. You produce an electric current, or we'd say, you induce an electric current. And depending on whether you turn it counterclockwise or clockwise, the current flows in opposite directions. In other words, if you turn it one way, it flows one way, and if you turn it the other way, it flows the other way. And you can actually measure this current if you have a sufficiently sensitive meter or if you very carefully attach this motor to a light bulb, to the two contacts on the light bulb, the brass part and the little tip on the end. Turn the crank vigorously and you'll actually see the bulb flicker. I've actually done it with these bulbs; it can be done. It's just a matter of manipulating the wires. It would probably take two people; one to hold it and one to turn the crank.

12: I noticed that they used two of these.

B: Yes, yes. Right.

12: We were using just one to light it.

B: True, but you can do it with one. What's the difference if you use two?

13: (40 seconds, unintelligible)

B: Have you tried it, and seen difference in brightness with one and with two? Try it and see. Okay.

Sister: . . . a flashlight.

B: Yeah, well, what we're asking really is, is there an observable difference here? Okay. Right. Speak up now, so that everyone can hear.

(sneeze)

14: Pardon me.

B: Okay, one nail is aluminum. What evidence do you have to have for that, Sister?

Okay, any other evidence? Okay.

15: Mr. Bartlett, when we used _____ (cut off).

B: Any other systems you'd like to tell us about? Okay. Now, question?

15: When we use two, it doesn't light at all.

B: Yes. Okay.

15: I don't know which end . . .

B: Which way did you have the two attached?

15: We didn't have them attached. That's okay?

B: Well it might make a difference. Now I'd like to give you another test. Please pay close attention. I would like for you and your partner -- going back to something that we discussed some time ago -- to spend about, between two and three minutes and I will time this, discussing any relevance that these three concepts may have for the decisions that you made at your table in terms of the system, the systems that you found today. I would like to recall our previous discussion about some of the aspects of interaction between people, specifically, and how people communicate with one another. And I would like for you to think about an aspect of human interaction which is called competition, or competitiveness, and I would like you to think of this in terms of both you and your partner together, and perhaps about you and your partner as opposed to the people across the table from you, or other pairs in the group. In other words, just what relationship might competitiveness have to decisions that you make about systems that you will define, let's say -- originality of the systems that you pick, or similarity to systems that you pick in relation to other person's systems, and so on. In other words, just think about this term, and also two aspects of a very personal interaction between you and your partner. Again going back to the aspect that we will call trust. In other words, how much information are you willing to share with your partner, how much information is your partner willing to share with you, and does this go across pairs or is it just within the pairs? Okay? And the third one is openness. That is, is there anything that you would not share with your partner or with someone else in the group about the systems that we're defining? Just how open are you in sharing information? Do you feel that there is any likelihood that you might hold anything back? Or that you would tell all about what you see in the system? Three minutes.

Please do not share any of this discussion with other members at your table. Just your partner.

Two minutes have passed, if you need any more time.

Okay now, I would like to ask each pair very briefly how you feel . . . I'd like each pair to tell us very briefly in a few words about how they perceived these items: competition, trust, openness -- in terms of the past day and whether or not they perceive any changes in relation to, let's say, the three sessions in which we've been operating. Let's begin at a different table this time. Let's begin with Mrs. _____.

Mrs. _____: As far as competition, there was competition because that is, we felt that way, because we wanted to do as well as each group and you asked for six systems and we wanted to try very hard to make sure that we had six or more if possible. As far as trust, we've had all the trust where we've been willing to share, and we haven't had any problems with that at all. As far as openness with each other, we've had that as far as the table. Because when their bulb lit, we certainly were trying, and they wouldn't show us.

B: Good for them.

Mrs. _____: So we had to figure that out ourselves.

1: Yours did, and your bulb didn't work.

Mrs. _____: But otherwise we've had complete openness and trust.

B: Okay, let's sample another table. Let's go back to Sister _____'s.

Sister _____: We didn't have any competition between us but we worked together to accomplish the end. We had complete openness with one another, and we shared all of our views with each other.

B: Okay. Do you perceive any change in these variables, let's say, over the three sessions or do you feel that they've been about constant for the three sessions?

Sister _____: I think we're a little more together now than when we first started.

B: Than you did at the beginning? Okay. Do you have any ideas why this might have happend? (5-second silence). Any suggestions?

Sister _____: We've worked together before.

B: Right, you're from the same school. Right, Miss _____ is in the same school, and I would assume that you knew each other before the program. Okay, let's sample another table. Let's try Mrs. _____'s pair.

Mrs. _____: Well, we said that there was no competition between the two of us at all.

B: Okay.

Mrs. _____: As far as trust goes, we were very good; and openness, we were willing to share and find out what the other one had to say, and I think that goes for the . . . .

2: We didn't share any information because . . .

Other Lady: But we couldn't help see the light go on.

B: Okay. A little bit of competition there? Let's try Mrs. _____'s pair.

Mrs. _____: Yes, well we didn't feel the spirit of competitiveness between us.

B: Right.

Mrs. _____: Of course, there was a competitive spirit in comparison to the rest of the group. We wanted to cheat as much as they did on . . .

3: Cheat?

(great uproar about "cheat")

B: That's interesting. The things we hear sometimes. Okay, yes?

Mrs. _____: We trusted each other and each other's judgment . . . and since you had told us not to "cheat," we didn't bother to find out what our pair partners were doing so . . . This is part of the experiment . . .

B: Right. Right. I had structured it to that extent. Okay, Mrs. _____, how about your pair?

Mrs. _____: Well, um, we didn't find any competition between the two of us. I think we trust each other. At first you know we started manipulating objects, it sort of seemed as if my partner decided that she was going through magnets, and I was going through electricity.

B: You split your subject matter a little bit then, huh? Okay, let's have another group opinion.

4: There was no competition between us.

B: How about the rest of -- how about the table . . .

4: No, because you've made it so pleasant that the competition I should think would be gone. We're all here to learn.

B: Okay.

4: We trusted from the beginning . . .

B: So you don't perceive competition with the other groups at all? It's more of a collaboration? Rather than? Okay.

4: Well I mean we didn't feel that we had to.

B: Right! That's what I mean. Okay, well we've sampled all the tables now, and I think that . . . Yes?

1: We, I just wanted to say one thing. I think this working in pairs is just great. It gave me more of a sense of security because I feel -- you know -- that I lack so much -- you know -- in science really and -- you know -- together, well I thought she knew more than I did, but I felt that security. I really did. And I thought it was great.

B: I, uh . . . Yes?

2: I have a question. Would this competition be a problem between children? Do you want us to find that out for you? I mean, how would we cope with it if we find it?

B: Um, well actually I was just bringing up the question because I felt that it's something that we might consider -- that we might consider the competitive element in the classroom. This is the same, _____, that we had before. Just please put your name at the top. It's shorter this time. You'll notice it's one less page. Should have three -- three pages.

1: I asked you this before: how does elementary science seem to me as a teacher or to other teachers?

B: To you personally, how does elementary science seem to you as a teacher -- that's first page? How does this kind of a science program seem to you, let's say as -- that's on the second page -- as opposed to elementary science in general? And on the third page, how do you think it would seem to children? This program. Yes, please put your name at the top. Please don't collaborate on your answers -- I just want your impressions. This is very much on a feeling basis here, and so it's very relevant just how you feel personally, on a very personal basis.

(7-minute pause, teachers writing)

I anticipate that the kits will be distributed on Friday morning. If they are not, they will be out very early this coming week and prior to your first observation. Right. Now actually you will notice that the first lessons are really introductory, using objects in the classroom and so actually you may begin at any time you like if you wish to get sort of a head-start, you may begin at any time that you like.

1: How many lessons shall we plan on?

B: I'd say that's strictly up to you. Now as I estimate it the way I would teach the unit, it would last about six weeks -- roughly. That is, teaching at least a couple times a week. But I'm not a speedy type of teacher, you know. I like to draw out the idea and make sure that it's pretty well fixed in each child's mind and I also like to do a lot of informal testing along the way and asking children under different circumstances about the same ideas.

1: You can do all this before the time the person comes . . .

B: Right, but you can do it while they're there too. You see, you can do anything you like when the observer is there.

2: Should they have had an introduction to it before the observer is there?

B: Not necessarily. Not necessarily.

3: We don't have to stick to this book?

B: You do not have to stick to the book.

3: Well what are we doing, a lesson . . .

B: No, M'am. These are lesson plans essentially, but you do not have to use them.

4: In other words, anything to do with science?

B: Right. The observer is coming. The observer will watch, but what you teach, the way you teach it, how long you teach it -- that's up to you. Okay?

5: You mean we don't have to write a lesson plan for this?

B: No, M'am. You do not have to write a lesson plan for him.

6: Does it have to be in this book?

B: Well, if you prefer to do something else, that's up to you. See what I mean?

7: I thought you wanted us to do, along the lines of . . .

8: . . . the method.

B: Right. In other words, I would prefer that they went along that way. But now what you want to do is up to you, you see, because you're not being judged on this. In other words, we're not evaluating your performance along this book. See what I mean?

9: You said you would tell us at this meeting.

B: I would tell you what? Pardon me.

9: What the whole idea of this was.

B: Oh, oh! Well, now -- the thing that I wanted to tell you, really, I want to talk with you about grouping more than anything else. And about interaction between ourselves in this group as this might relate to interaction between children within your classroom, and how this kind of procedure might be used in organizing your classroom and in promoting interaction between children in preference, let's say to interaction between teacher and the child. In other words, getting children to work together, not just thinking for themselves, but to use the teacher in a particular way. To use the teacher as a resource person in the classroom, rather than as a repository of knowledge.

Because really, the kinds of activities children are doing here, they can get the knowledge that you want them to get themselves -- on this level, you see? In other words, the teacher doesn't really have to be a dispenser of knowledge on this level. Now on some levels, of course, she does. But at this particular type of activity the child can really get all the information he needs by himself or from another child who happens to be perhaps a little more perceptive or have a few more experiences in his repertoire.

1: Would you like the children to pair themselves off? Would you suggest . . .

B: Um, I do it a couple of ways myself. Sometimes if I feel that it's going to be a productive pair, I'll let them do it selfselection. On the other hand, it depends really on the atmosphere of the classroom whether or not you can do that. Every class varies so darn much that I'd say that you really have to be the judge of this. In some of my classes I can let them pair themselves and in some classes I can't. I think you'll really have to make your own decision. And you may not want to pair, you may want to put them in fours, or in sixes, or in some other group. You may want to use different groups for different purposes, you see at different times. You may not want to group at all.

2: Would four be too many?

B: Would four be too many? It really depends on what you're doing.

What I usually do is, I always set them up in pairs and then I have the pairs in clusters so that they have a partner, but they may be working in a cluster of four or six. I mean, but that's only my advice. I don't want to influence you in your selection of any kind of classroom management. That's not the intent of this program. The intent of this program is to give you materials to work with so that you can try something . . .

3: Each child would have, uh, I mean --

B: Would have materials. Right. Each two children would have them. Right.

Please let me have your papers and put your bags in the box. Miss Green?

Miss Green: And may I please have your attention a second? I know you were asked and committed to the three sessions, but as I have spoken to the session that meets Tuesdays, you will be invited back on a voluntary basis for another session after the teaching period is over. Because I feel you might want to discuss what has taken place, sort of tie ends together, and as I had said at the beginning, I would like to show you -- the New York City people -- how the materials can be used and related to their course of study and the people who have to be geared to the State program, how it can be used with the State course of study. So you will be invited again -- most likely on the second week after the Easter Vacation -- after the Spring Vacation. Thank you.

(follows a discussion with Mrs. _____ and Mrs. _____ (partners) regarding their feelings about being assigned arbitrarily to this program by their principal).

APPENDIX I

Observer Commentary -- A Taxonomy:

Classification of Observer Comments[1]

1. TEACHER ACTIONS, INSTRUCTIONAL STRATEGIES, POSITIVE:

Group work
Game used
Individual work
Positive control
Homework given, related to lesson
Teacher does good questioning
Teacher encourages pupil-pupil interaction
Teacher summarizes
Teacher relates innovation to other subject
Teacher circulates
Teacher questions pupil on operation
Teacher follows training program model
Pupils all involved in "question-answer"
Accepting, supportive teacher responses

2. TEACHER ACTIONS, INSTRUCTIONAL STRATEGIES, NEGATIVE:

Large group discussion
Much teacher talk
Activity slowly paced
Teacher refers to manual
Teacher keeps manual in hand
Most communications teacher-pupil
Teacher questions, pupils respond
Teacher prompts for answers
Teacher lectures
Aversive control
Formal recitation
Teacher terminates, lost control
Pupils had to wait too long for a turn

3. TEACHER ACTIONS, MATERIALS USE:

Chalkboard summary
Little organization
Poor materials handling
Charts used
Excellent organization
Materials handled efficiently

4. PUPIL ACTIONS, VERBAL, POSITIVE:

Pupil-pupil interaction
Pupils described objects
Pupils record observations
Comparisons of properties
Pupils noisy
Pupils verbalized sorting of objects

5. PUPIL ACTIONS, VERBAL, NEGATIVE:

Pupils quiet
No pupil-pupil interaction
Pupils do not attend to other pupils
Little pupil-pupil interaction

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[1] See Table 11 on page 82 for frequencies reported by observers.

6. PUPIL ACTIONS, MANIPULATIVE:

Pupils sorted objects
Pupils share materials
Pupils break objects
Work groups exchanged plants
All pupils handled materials
Pupils' time effectively used experimenting
Restricted study of materials
Little handling of materials
Pupils do not share materials
Confusion generated by pupils opening bag

7. OBSERVER EVALUATES TEACHER, POSITIVE:

Lesson moves quickly
Nice lesson
Nice teacher
Lovely lesson
Lesson a pleasure
Terrific!
Pleasing personality
Teacher earnest
Teacher alert
Interesting
Productive
Teacher enthusiastic
Good teacher-pupil rapport
Teacher exciting
Teacher has quiet voice
Teacher manner pleasant
Teacher relaxed
Teacher reserved
Teacher resourceful
Teacher conscientious
Teacher dramatizes
Teacher experienced
Divergent questioning
Teacher patient
Teacher eager
Exciting teacher
Good lesson
Pleasant lesson
Enjoyable lesson
Teacher has a nice sense of humor
Teacher sincere
Successful
Effective
Teacher has quiet manner
Teacher cooperative
Teacher friendly
Teacher hard working
Teacher displaying curiosity
Teacher does creditable job
Teacher encourages originality
Teacher projects interest
Teacher self-confident
Teacher spreads pupil participation
Excellent teacher preparation
Teacher employs many good techniques
Pupils encouraged to think before answering
Teacher more comfortable during 2nd lesson
Teacher laughs at potentially upsetting pupil moves
Pupils eager
Pupils relaxed
Pupils resourceful
Pupils happy
Pupils receptive
Pupils alive
Bright group
Pupils excited
Pupils verbalize well
Pupils work quickly
Pupils show deep thinking
Pupils gave good responses
Pupils involved
Pupils responsive
Pupils enjoy
Pupils interested
Pupils alert
Pupils well-behaved
Nice Class
Pupils enthusiastic
Pupils fascinated with syringe
Pupils (slow) try hard to follow directions
Pupils highly motivated
Pupils anxious to learn

8. OBSERVER EVALUATES TEACHER, NEGATIVE:

Lesson draggy
Lesson moves slowly
Teacher rude to observer
Teacher hostile to pupils
Meaningless lesson
Lesson uninteresting
Unrewarding lesson
Dull lesson
Teacher nervous
Meandering approach

Lesson got away from her
Pupils not sure of object of lesson
Unfortunate teacher was selected
Teacher unpleasant with pupils
Teacher has "slightly hostile attitude"
Teacher very poor
Commonplace lesson
Teacher does not project interest
Teacher has poor control of class
Too many concepts for one lesson

Teacher could have chosen better objects for examination
Teacher fails to use pupil exploration well

Discipline required
Lesson too long
Teacher not prepared
Straight rows
Teacher shouts
Convergent questioning

Teacher has loud voice
Petty disciplining
Teacher felt my role was testing
Some pupils excluded, given spelling to do
Teacher cautions pupils about noise
Teacher gives confusing directions regarding materials use

Teacher new, lacks experience
Teacher shows little enthusiasm
Teacher verbalization clumsy -- limited
Teacher not sure of what to do next

Pupils bored
Difficult group
Impossible class
Poor class
Pupils had fun
Pupils restless
Pupils verbalize poorly
Pupils lost interest

Pupils "fool around"
Pupils playing, not learning
Pupils have limited attention span
Dull group
Pupils had a good time
Pupils inattentive
Pupils give routine responses
Pupils like teacher, but are not stimulated by her